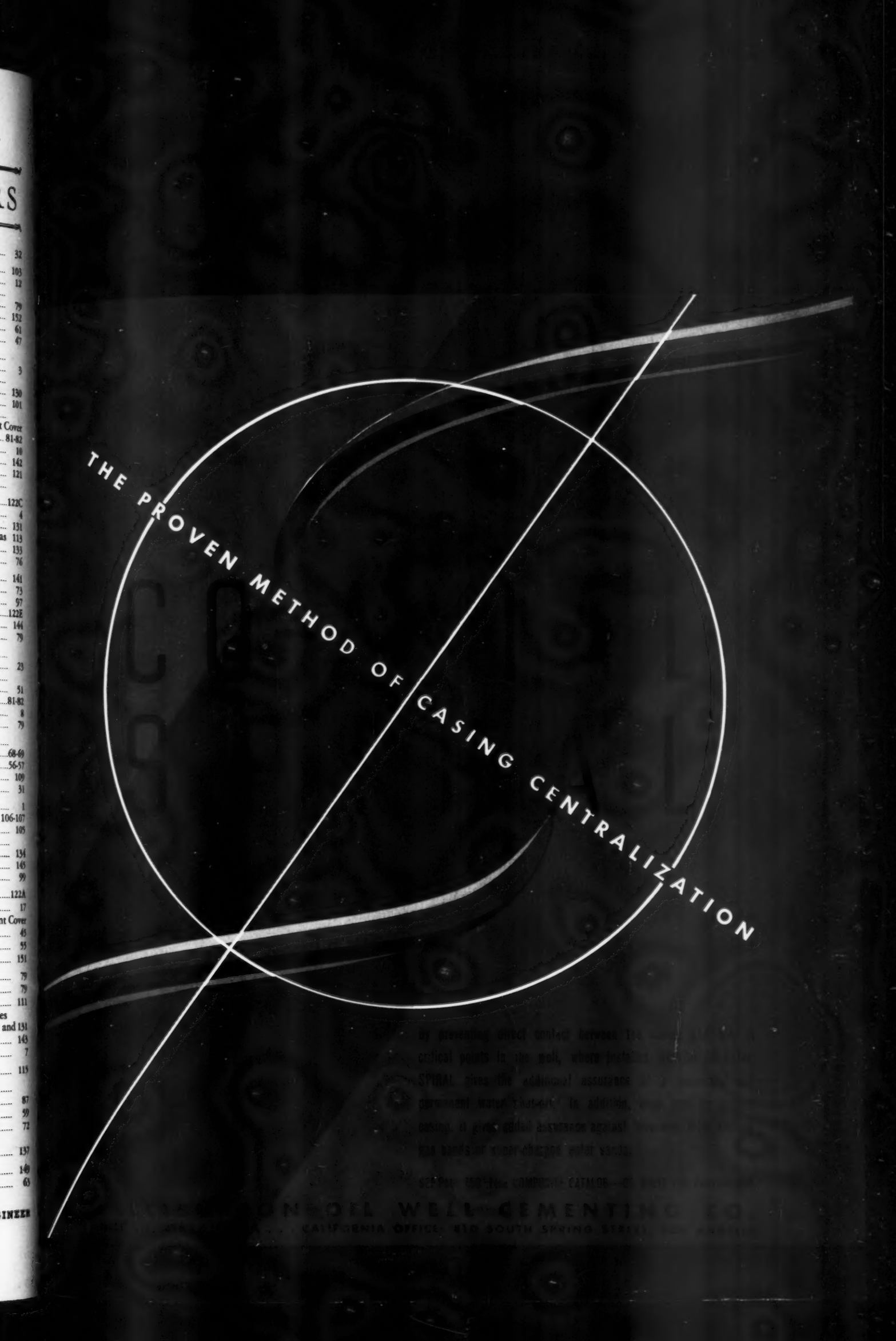
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A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

- Second World Petroleum Congress—June 14, 15, 16, 17, 18, and 19, Paris, France.
- Oil and Gas Golden Celebration—June 20, 21, 22, 23, 24, 25, and 26, Findlay, Ohio.
- American Society For Testing Materials, 40th Annual Meeting—June 28, 29, 30, July 1, and 2, Waldorf-Astoria Hotel, New York City.
- California Natural Gasoline Association—July 1, Richfield Building, Los Angeles, California.
- Interstate Oil Compact Commission—July 12 and 13, Santa Fe, New Mexico.
- American Chemical Society—September 6, 7, 8, 9, and 10, Rochester, New York.
- American Gas Association, 19th Annual Meeting—September 27, 28, 29, 30, and October 1, Cleveland, Ohio.
- Oil-World Exposition, Inc.—October 11, 12, 13, 14, 15, and 16, Houston, Texas.
- Independent Petroleum Association of America, Annual Meeting—October 14, 15, and 16, Houston, Texas.
- American Association of Petroleum Geologists, Mid-Year Meeting—October 14, 15, and 16, William Penn Hotel, Pittsburgh, Pennsylvania.
- Mid-Continent Oil and Gas Association of Texas, Annual Convention—October 29 and 30, Dallas, Texas.
- American Petroleum Institute, 18th Annual Meeting—November 9, 10, 11, and 12, Stevens Hotel, Chicago, Illinois.
- International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, 1938, Tulsa, Oklahoma.

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Pictured above is a 7/8" x 6000' Marathon Drilling Line purchased by C. T. McLaughlin & Co., Inc., Drilling Contractor of Midland, Texas, and in use on the John Scharbauer Well No. 3, Tidewater Lease in Penn Pool, Ector County, Texas. Those shown are, left to right: Charlie Dyar, driller; Joe Russell, tool dresser; C. T. McLaughlin, contractor, and E. E. Lambert, representative of A. Leschen & Sons Rope Co. In the foreground are the members of the celebrated Leschen "Quality Quins"—Durability, Strength, Elasticity, Flexibility and Toughness. These, of course, are always found wherever there is a Leschen line.

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The Course of Oil

By K. C. SCLATER

A Great Pioneer Passes The Board of Directors of the American Petroleum Institute records with sorrow the death, May 23, 1937, of John D. Rockefeller, pioneer of the petroleum industry and benefactor of the Institute, at Ormond Beach, Florida, at the age of 97.

John Davidson Rockefeller was born July 8, 1839, at Richford Village, Tioga County, New York. He became associated with the petroleum industry in 1863 and actively interested in 1865. In 1870, with associates, he organized the original Standard Oil Company of Ohio. In 1882 he directed the organization of the Standard Oil Company of New Jersey, and served as president of the corporation until he retired from business life in 1911.

Mr. Rockefeller's business acumen and foresight led to the inauguration of many of the policies and practices which have enabled the petroleum industry to assure the nation of an uninterrupted supply of petroleum and its products, and to render to customers a continuing service which has been outstanding in industrial history. His vision encouraged the development and constant improvement of many operations and processes essential to the industry's progress.

By a gift of $250,000 to the Institute in 1926, he initiated and aided in financing a five-year program of fundamental research in petroleum designed to make available to the entire industry scientific knowledge necessary to the advancement of petroleum arts and sciences, and so gave impetus to the technical research which since has been a continuing activity within the industry.

The Board of Directors of the American Petroleum Institute hereby expresses to the family, the associates, and the friends of John D. Rockefeller the profound sense of loss felt by the Institute and by the industry in his passing.

Adopted by the Board of Directors of the American Petroleum Institute at its Midyear Meeting at Colorado Springs, the foregoing Resolution in Memoriam is the industry's simple, sincere tribute to a great pioneer.

Pumping Slant Wells Profitably Evidence comes to hand that slant wells drilled at high angles may be produced profitably by pumping. Data on a group of slant wells in the Huntington Beach tidelands field, California, are interesting from the standpoint of lifting cost. Accurate costs kept on a group of nine tidelands wells on steady production show that the average unit lifting cost was 12.6 cents a barrel. These costs include all direct and indirect labor, superintendence, materials, supplies, taxes, and charges from other departments, but exclude royalty and depreciation. As these wells are approximately 4400 feet deep and have comparatively large slant angles, the results are commendable.

Frequently the question has been raised regarding the economy of pumping slant wells drilled at a high angle of deflection. The experience with the group of wells just referred to would seem to indicate that the possibilities in pumping such wells profitably are greater than might be expected.

In submitting these data and costs on pumping slant wells, the author takes occasion to offer the opinion that the slant holes he discusses will never be pumped successfully to the stripper stage of from ten to twenty barrels daily.

Drilling slant holes to tap a greater portion of the reservoir with less wells is another important phase of this question that must be considered. The economics involved can be greatly simplified by compiling cost data from actual field practice similar to that just discussed. More of such data are desirable.

Obscuring Technical Progress President Axtell J. Byles of the American Petroleum Institute at the Colorado Springs meeting paid a tribute to the technical man but deprecated taxation when he said: "Technical problems, such as will be studied and discussed at this meeting, are causing the petroleum industry considerably less worry than tax problems affecting the industry and its customers."

"By study, research, experimentation, and persistence, the industry's technical men have overcome difficulties regarded only a few years ago as virtually insurmountable. The industry constantly is developing improved technique in oil prospecting and in locating new sources of supply. Oil wells are being drilled to 10,000 feet and more to tap large subterranean reservoirs. Old and supposedly exhausted oil fields are being restored to production. More recently developed fields so are being operated as to perpetuate their producing life and to assure the maximum recovery of oil with the minimum waste and loss.

"Refining processes are being developed and improved to the point where waste is virtually nil, flexibility of operation is an accepted practice, and efficiency is constantly rising. Costs of transportation and of marketing are being reduced."

All these benefits contributed by the technical man, however, are obscured by heavy taxation, a problem in the solution of which even the technician seems impotent.

« « HIGHLIGHTS IN OILDOM » »

Town Lot Play Likely For Sapulpa

A new drilling ordinance passed by the city of Sapulpa, Oklahoma, permitting the drilling of one well to each block promises to result in a new town-lot drilling campaign there. The acreage to be developed is in the southeast of 36-18-11, and a part of the southwest of 36-18-11e. Additional acreage later may be included.

According to provisions of the ordinance each operator must post a bond with the city commissioners based on the value of the surrounding property; and the test wells must be near the center of the block and not less than 125 ft. from any building outside the block.

The first sand to be penetrated will be the Red Fork at approximately 1100 ft., the next the Glenn at 1500 to 1580 ft., but the Wilcox sand at around 2000 ft. will be the ultimate goal.

●

Salt Water in 118 Wells in Rodessa Field

Latest reports reveal that a total of 118 wells in the Rodessa field are showing salt water, 99 on the Louisiana side and 19 on the Texas side. Eight of the 99 on the Louisiana side are listed as dead and 20 as off production. Three of the 19 on the Texas side of the field are given as off production.

●

Unrestricted Drilling for Langston Township

A ruling of the Oklahoma Corporation Commission permits the drilling of an oil well on each block within the city limits of Langston. In so ruling the commission denied the application of its conservation officer, W. J. Armstrong, to apply to the town of Langston the 10-acre well-spacing law passed by the fifteenth legislature. As the application was denied one well now can be drilled to approximately every three acres.

The move to govern spacing of wells in Langston, whose population is composed entirely of Negroes, was instituted following the bringing in of a large producer northeast of the town about three months ago. Armstrong's application had the support of several major companies. Negro citizens had protested the application.

●

East Texas Crude Advanced To $1.35 Bbl.

An advance of eight cents a bbl. has brought the price of East Texas crude oil to $1.35. The Magnolia Petroleum Company initiated the price increase on May 21, being followed immediately by the Tide Water Associated, Atlas Pipe Line Company, Bell General Pipe Line Company, DeSoto Crude Oil Purchasing Company, Root Petroleum Company, and the Republic Oil and Refining Company. On May 24 still other companies operating in East Texas fell in line: the Sun, Humble, Shell, East Texas Refining Company, The Texas Company, Arkansas Fuel Oil Company, Atlantic Refining Company, Stanolind, and Panola Pipe Line Company. Gulf and Sinclair Prairie met the advance on May 25. All price advances were made retroactive to 7 a.m. May 22.

New Ruling in Texas Well-Spacing Case

A new ruling has been handed down in the now famous case of C. H. Brown vs. Humble Oil and Refining Company involving Rule 37, relating to well-spacing. The latest decision is by the Third Court of Civil Appeals at Austin and justifies the Railroad Commission in granting Brown a permit for a second well on a three-acre tract in East Texas.

As is well known to those who have followed the matter, the case has been in litigation since 1932 and revolves about the right of Brown to drill a well on his portion of a subdivided three-acre tract. The Railroad Commission granted him a permit to drill under the exception to Rule 37, which allows closer spacing of wells than is generally prescribed in order to protect vested rights, prevent confiscation, and needless dissipation of oil and gas.

The case has been heard by numerous courts, some rendering decisions in favor of the Humble and some in Brown's favor. The latest decision, that of the Third Court of Civil Appeals, resulted from an appeal by the Humble from a Travis County District Court decision. The Humble now is expected to ask for a rehearing or apply to the Texas Supreme Court for a writ of error on the appeals court's decision. Ultimately the case may find its way to the Supreme Court of the United States.

●

To Study Oil Industry in Pennsylvania

Governor Earle recently signed a bill authorizing the creation of a committee to study the oil industry in Pennsylvania. Four members have been selected and a fifth will be named later. For some time oil men in the Pennsylvania Grade area of the state have favored an impartial inquiry that would present the facts concerning one of the state's ranking industries.

The four members of the committee selected are: Judge Ralph W. Smith, Pittsburgh; John E. McComb, Rouseville; William H. Godfrey, Pittsburgh; and Senator E. J. Thompson, Philipsburg.

●

Labor Wages High in Petroleum Refining

The petroleum refining industry stands second only to building construction in providing the highest average hourly earning for all wage earners, and leads other industries in paying the highest average hourly entrance wage rates for common labor, according to the "Monthly Labor Review," published by the United States Department of Labor.

Petroleum refining average hourly earnings are reported as 83 cents as against 84 cents for building construction, and as compared with 57.2 cents for manufacturing, and 78.5 cents for electric light and power. Hourly entrance rates for adult male common laborers were reported as 52.5 cents for petroleum refining, as against 42.4 cents for manufacturing, 42.9 cents for public utilities, and 50.9 cents for building construction.

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Progress of Major Pipe Line Work

THE Barnsdall Oil Company's 6-in. oil line from the Placedo field, Victoria County, Texas, to the company's new refinery at Corpus Christi has been completed ahead of schedule. The length of the line is 70 miles. Work began April 20. Williams Brothers, Inc., Tulsa, Oklahoma, were the contractors.

●

Oklahoma Pipe Line Company has plans under way for a 12-mile 8-in. oil line from Wewoka, Oklahoma, south to the Canadian River; a 14-mile 8-in. oil line from Fittstown to Centrahoma, Oklahoma, and a 16-mile 6-in. line from Francis to Spaulding, Oklahoma. The first two lines will be constructed by the company's own organization, using the Lindeweld method of oxy-acetylene welding for all joints.

●

A 20½-mile, 8-in. oil line will be laid for the Humble Oil and Refining Company from the Baytown refinery to the Anahuac field. Williams Brothers, Inc., Tulsa, Oklahoma, have been awarded the contract. The same company also has been given a contract for taking up eight miles of 6-in. line between Baytown and Barbers Hill, five and one-half miles of which will be relaid between Wallisville and Anahuac.

●

The Home Oil and Refining Company of Great Falls, Montana, proposes the construction of a 105-mile pipe line from the Cut Bank field to its refinery at Great Falls. The line would pass through the Pondera field where the company has producing properties. The refinery, which would be the destination of the crude, has a capacity of 1000 bbl. daily.

The Home Oil and Refining Company recently completed a deal whereby the producing properties of Nadeau Brothers and A. B. Cobb in the Cut Bank field were merged with it, resulting in the company becoming the largest independent in the northwest with its own production, transportation, refining, and marketing facilities.

●

The Shell Pipe Line Corporation has completed the laying of a 6-in. line from its Barnsley station in Crane County, Texas, north to the Goldsmith area, a distance of 48 miles. The route of the line is through the Penwell and Harper pools of southern Ector County.

●

A 58¼-mile gas line is to be laid by the Pacific Gas and Electric Company from the Rio Vista gas field of Solano County, California, to connect with existing facilities. From the field to a point near Dixon 5¾ miles of 12-in. line will be laid; from there to the Napa station 26 miles of 10-in. will be laid, at the latter point a connection being made with the Kettleman line to Pataluma; another 10-in. line 14½ miles in length will connect the Rio Vista main line with the 6-in. between Dixon and Davis; and from Davis to Spreckels a 12-mile 8-in. line will be constructed. The project is expected to involve an expenditure of approximately $900,000.

●

Construction of a 6-in. pipe line from the Schuler area of Union County, Arkansas, by the Root Petroleum Company, has been announced. Crude will be transported from the field to the company's refinery approximately 14 miles east.

The Kansas Pipe Line and Gas Company is extending its system from the Otis field, Kansas, westward to McCracken. Later the line will be laid to Alexander and Ness City.

●

Recently the Lion Oil Refining Company completed a 4-in. gasoline line from its refinery at El Dorado, Arkansas, to Champagnolle Bluffs, on the banks of the Ouachita River, a distance of 12 miles. A loading dock has been provided at Champagnolle, at which point gasoline will be loaded onto barges for distribution at points on the Ouachita and Mississippi rivers.

●

The O'Hern Pipe Line Company, affiliated with the Crude Oil Pipe Line Company, Corpus Christi, Texas, has started construction of a 4-in. line from Freer, in Duval County, Texas, to Bruni, a distance of 32 miles. The work is being done by the company's own construction personnel, and the line is being coated in the field with hot enamel. A pump station will be constructed in the O'Hern field.

●

The Texas Pipe Line Company's existing 6-in. line from Marrero, Louisiana, across the river from New Orleans, south to the LaFitte field is being looped by an 8-inch. The total length of the loop will be 16 miles. The pipe is being coated with enamel in a central yard. The Latex Construction Company, Houston, Texas, is the contractor.

●

From Baton Rouge, Louisiana, to Scotland, a distance of six miles, the Baton Rouge Electric Company is laying a 10-in. gas line. Work began early this month. The pipe is being coated with enamel in a central yard, machine applied. The Latex Construction Company, Houston, Texas, is the contractor.

●

Sloan and Zook Company, Bradford, Pennsylvania, will erect two 15,000-bbl. tanks at its Myrtle, Pennsylvania, tank farm and lay a gathering system to provide for transportation of crude oil from the Allegany field of New York to its refinery at Warren, Pennsylvania. The crude will be picked up from the tank farm by the Bradford Transit Company and moved to its destination at Warren.

●

Bechtel and Kaiser, Inc., San Francisco, California, have been awarded the contract for constructing a 21-mile, 10-in. gas line for the Mountain Fuel Supply Company from Clay Basin, Utah, to connect with the company's trunk line at Salt Lake City. H. C. Price Company, Bartlesville, Oklahoma, has the contract for electric-welding the line.

●

John Hastings has been granted a franchise for the laying of an oil pipe line from the fields of Starr and Hidalgo counties, South Texas, to tidewater at the Port of Brownsville. The franchise gives Hastings one year in which to start construction of the line.

●

The Great Lakes Pipe Line Company will construct a terminal at Kansas City, Kansas, for its new line being laid from Barnsdall, Oklahoma, looping its existing facilities. The new 8-in. line is by way of Paola and Humboldt, Kansas.

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Latest Activities In The Oil Fields

COMPLETION of Edwin M. Jones' No. 4 Harry Ezzell, five miles south of the Calliham field, has opened a new field in McMullen County, Texas. Total depth of the well is 1544 feet. On the first test the well gauged 186 bbl. of 19.7-gravity crude. Pressure on the tubing was 100 lb., and on the casing 410 pounds.

●

Two new fields appear likely for the Gulf Coast area of Louisiana, one in Lafourche Parish and the other in St. Charles Parish. Fohs Oil Company's No. 1 State Long Lake in Lafourche Parish at the last report was preparing to set casing at 9406 ft. after having a good showing of oil on core tests. The Amerada Petroleum Corporation and the Louisiana Land and Exploration Company also had several showings of oil in their test, No. 1 State Bayou Des Allemands, in the Black Prince Island prospect, St. Charles Parish. The total depth is 6915 feet.

●

A small showing of 20-gravity crude has been had by the El Rio Oil Company's wildcat in Oxnard district of Ventura County, California, two miles east of Oxnard. The test is at a total depth of 2717 ft., and while the well has not been completed and the showing is slight, it has created sufficient interest that additional exploration work in the area may result.

●

Gulf Production Company's No. 1 George W. Shahan, a semi-wildcat in Lea County, New Mexico, two and one-fourth miles southeast of Jal, made an initial flow of 125 bbl. in two hours after being brought in at a total depth of 3280 feet. Production is from the sandy-lime section.

●

Pray and Caldwell's No. 1 Flynn, in Billings Township, Michigan, is one of the recent important developments in that state. After being treated with 2000 gal. of acid the test came in producing from 350 to 450 bbl. daily from the Dundee lime. This discovery opens for immediate development a new territory southeast of the original Buckeye play.

A new producing horizon has been opened in the Lance Creek field of Wyoming, by the Ohio Oil Company. That company's No. 5 Leo OPC-16 was brought in from the lower Minnelusa (Tensleep) formation at a total depth of 5537 feet. On the initial production test the well made 600 bbl. daily through tubing choke. The crude is of 42 gravity, having a paraffin base.

●

Western Kiowa County, Oklahoma, was the recent scene of a shallow oil discovery by E. A. Debolt and Associates. No. 1 Burnett, at a total depth of only 982 ft., appears to be good for 50 bbl. of oil daily, together with 1,000,000 cu. ft. of gas. The discovery well is across the Red River from the old Granite pool.

●

In wildcat territory, 14 miles northwest of Ness City, Kansas, oil has been found by Sidney H. Keoughan of Casper, Wyoming, S. M. Newton, and the Oriental Oil Company. The well, No. 1 Dan Tenny, was drilled to a total depth of 4381 ft. in the Mississippi lime, and at that depth the hole filled 3400 ft. with oil. When swabbed it made 60 bbl. of 44-gravity oil in an hour.

●

Zavalla County, Texas, has been given her first oil production six miles northeast of Batesville. The discovery well is H. F. Wilcox's No. 1 T. J. Gilliam, with production from the Edwards limestone. The well was drilled to a total depth of 3947 ft., and on an eight-hour test made 1460 bbl. of oil. The corrected gravity is 18.6 degrees.

●

The largest gas well in the history of the state has been completed in West Virginia. The Hays Oil and Gas Company's test on the E. C. Humphreys farm, Poca district, Kanawha County, gauged 18,000,000 cu. ft. daily. The well is on the Milliken anticline, and the total depth is 4804 feet.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.19-143
Playa Del Rey	.80-1.16
Coalinga	.70-.90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .93-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.42
Pennsylvania	
Bradford	2.67
Southwest	2.42
Eureka	2.37
Buckeye	2.22
Corning	1.32
West Virginia	1.67
Canada	2.10-2.17

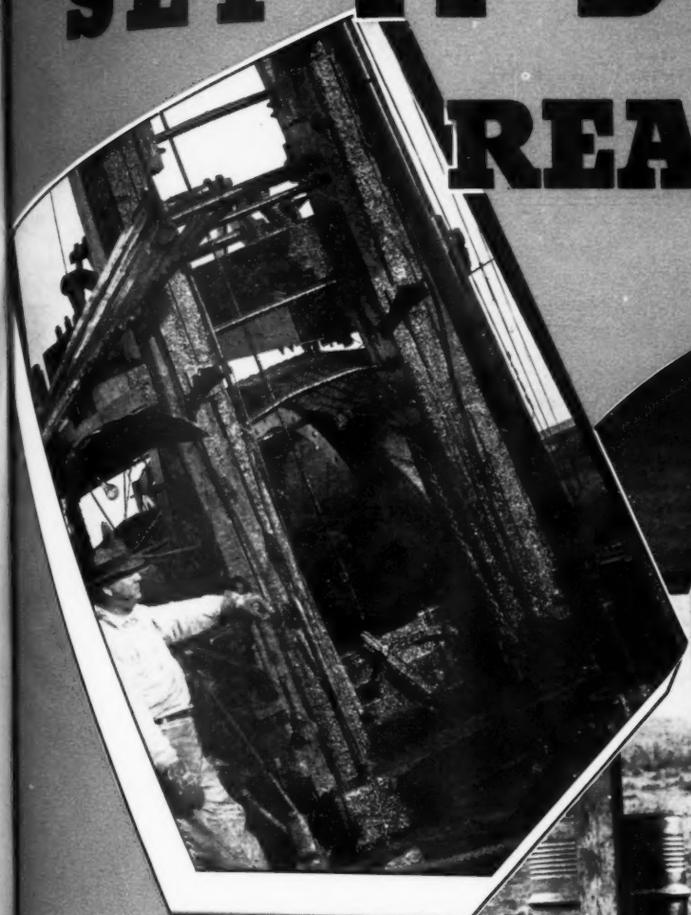
DAILY AVERAGE CRUDE OIL PRODUCTION

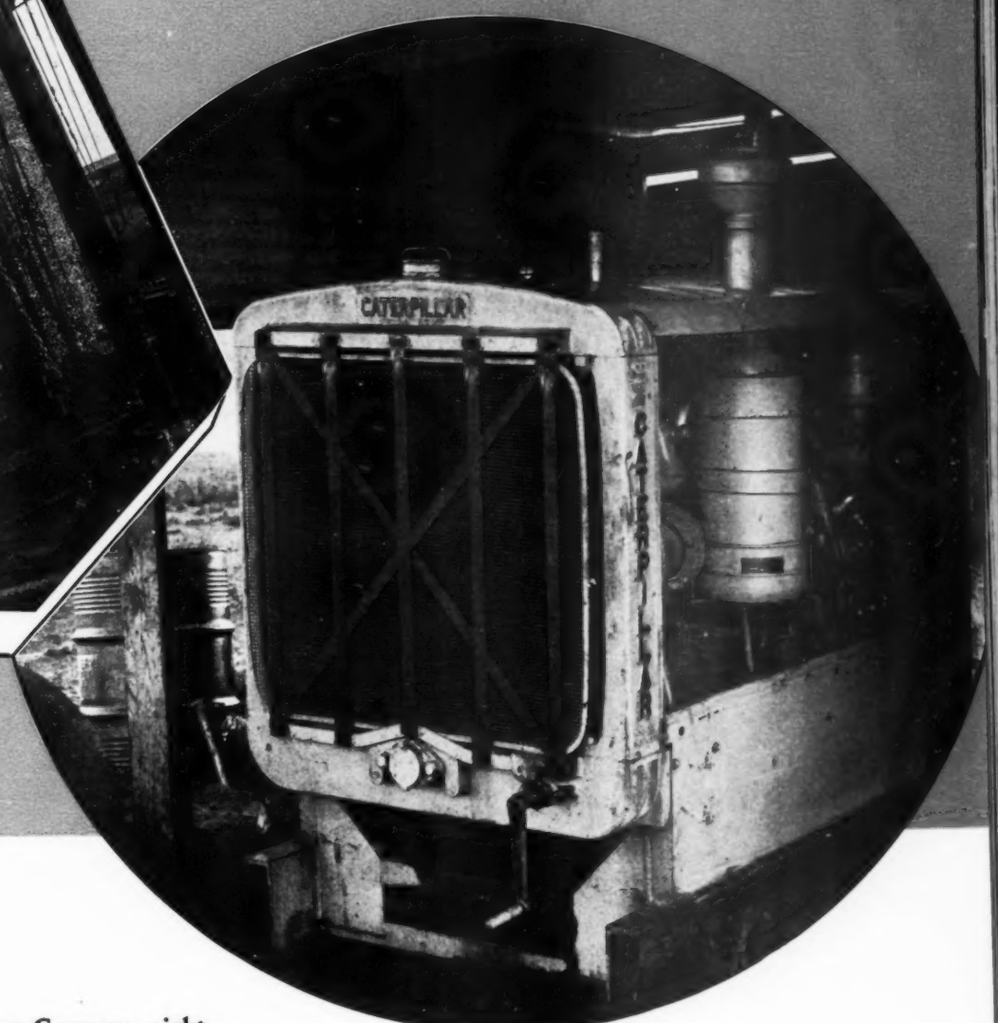
Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (May)	Week Ended May 29 1937	Week Ended May 1 1937	Week Ended May 30 1936
Oklahoma	622,700	660,800	665,600	531,600
Kansas	187,100	202,650	198,350	155,300
Panhandle Texas		87,100	78,800	62,450
North Texas		74,050	70,550	58,350
West Central Texas		32,950	32,750	25,450
West Texas		209,900	199,600	177,700
East Central Texas		124,050	118,200	51,850
East Texas		462,200	459,250	435,650
Southwest Texas		236,350	229,350	150,950
Coastal Texas		206,700	199,400	182,850
TOTAL TEXAS	1,340,800	1,433,300	1,387,900	1,145,750
North Louisiana		78,750	73,650	84,600
Coastal Louisiana		167,850	178,350	148,650
TOTAL LA.	249,400	246,600	252,000	233,250
Arkansas	28,500	27,150	27,000	29,850
Eastern	117,400	119,650	120,500	114,600
Michigan	34,900	44,450	46,850	32,950
Wyoming	49,000	49,800	51,600	36,150
Montana	15,200	15,400	16,850	17,050
Colorado	4,800	3,600	4,650	4,600
New Mexico	99,800	112,200	105,950	74,850
TOTAL EAST OF CALIF.	2,749,600	2,915,600	2,877,250	2,375,950
California	583,300	658,100	620,200	568,000
TOTAL U. S.	3,332,900	3,573,700	3,497,450	2,943,950

"SET IT DOWN-IT'S READY TO GO"





This well has just been spudded in, and illustration shows cleaning tool coming out of hole.

DAVE DUNCAN, head of the Ajax Drilling Company, right crisply describes the completeness of the "Caterpillar" Diesel Engine: "What I like about it is that you can put it on skids — set it down on the job and it's ready to go to work." He also finds it "the fastest power on control."

Operating in the Dodge-Denman Pool, in Texas, his 125-hp. engine is connected by flat-belt drive to a spudder that drilled 2919 feet to the sand in 30 days. Fuel-and-lubrication costs, $135 — about 4.6c per foot, or *less than 19c an hour*.

On any kind of work, in any field or industry, "Caterpillar" Diesel Engines are establishing low-cost records that are not even approached by other types of power. Their maintenance, likewise, is surprisingly low.

SEVEN SIZES — from 44 to 160 hp. Complete information is available through our nearest dealer or by writing direct to us.

Low prices of "Caterpillar" Diesel Engines with their high standard of quality are made possible by large-volume production. . . . These engines are used in thousands of tractors and road machines, in the equipment built by 83 machinery manufacturers, and by hundreds of other power users.

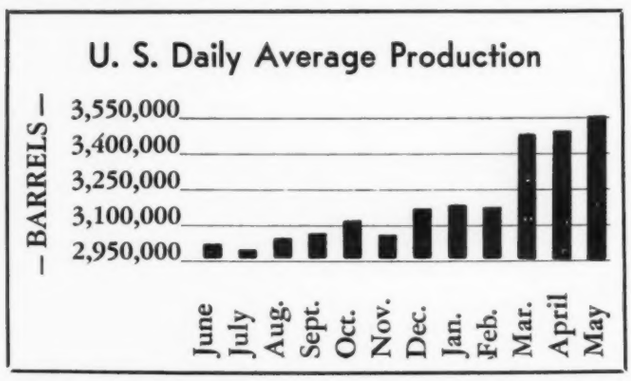
CATERPILLAR DIESEL ENGINES

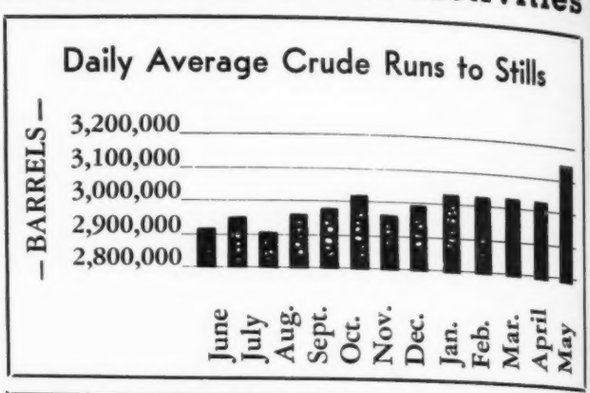
REG. U.S. PAT. OFF.

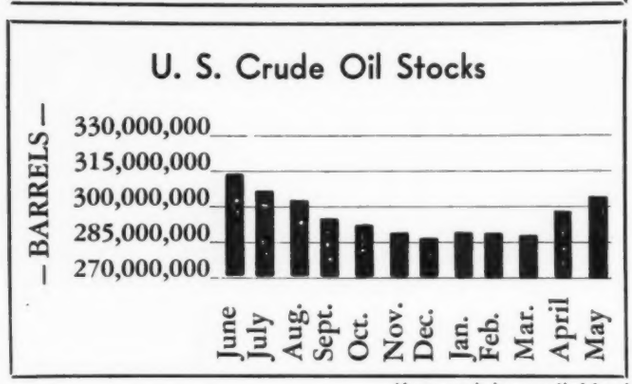
CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

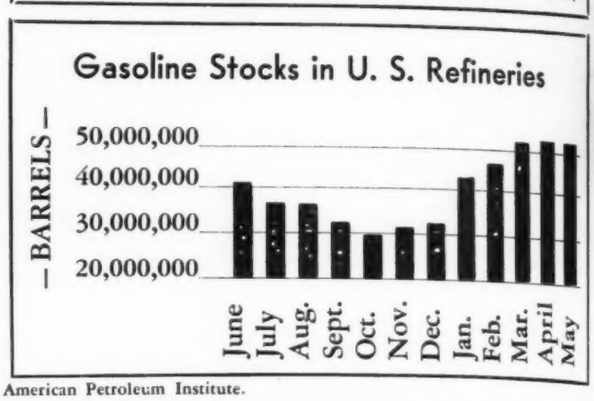
WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

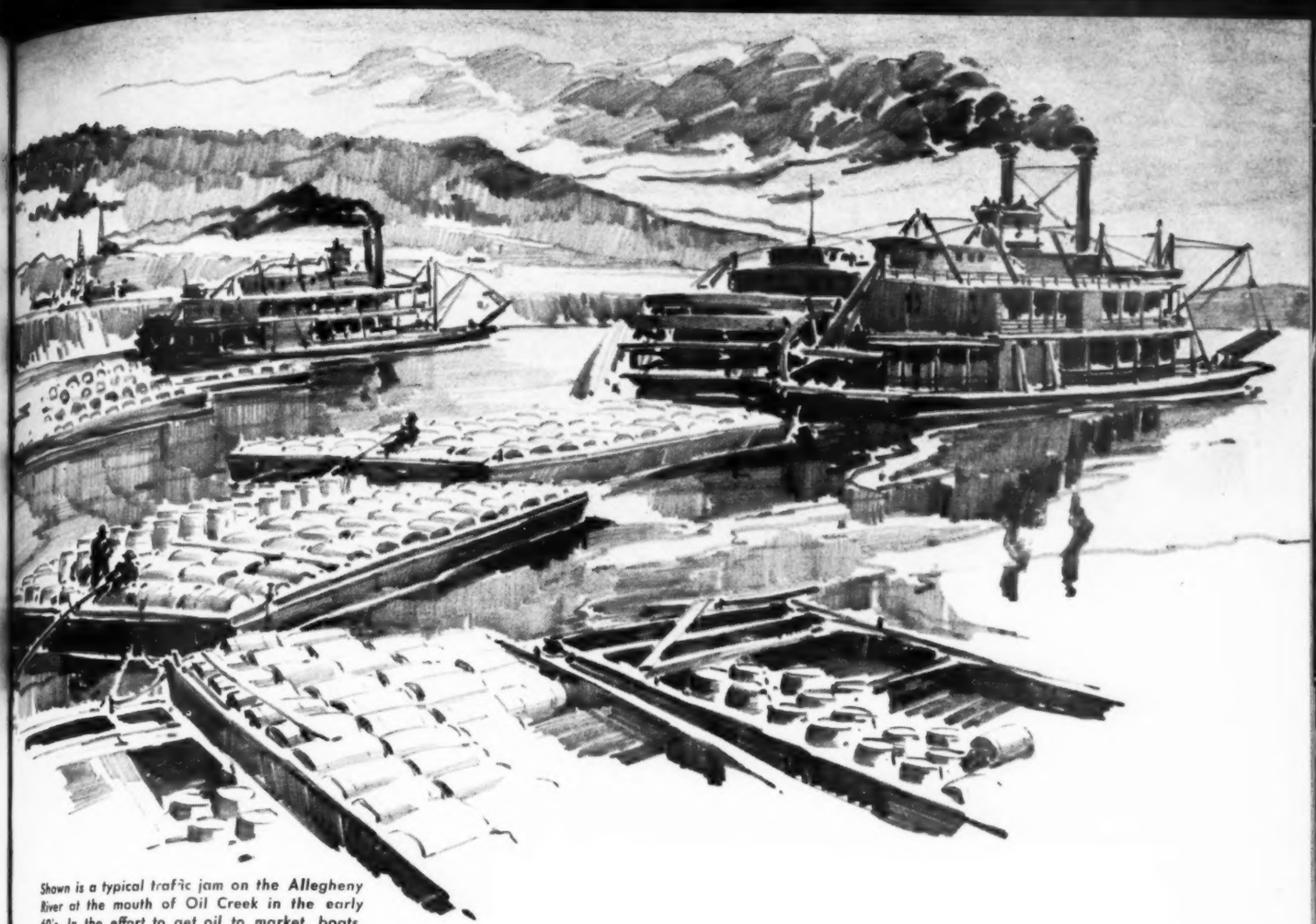
Summarized Operations in Active Fields for May, 1937

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	199	189	39	112	3500-3700	2	40	Rotary
Duval County	43	34	20	57	1554-2900	2	22	Rotary
Archer County	33	17	3	18	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	66	65	60	131	1700-3900	2	40	Rotary
Refugio	13	13	2	12	4900-5900	2	38	Rotary
Nueces County	55	49	25	59	3922-5878	2 or 3	21-54	Rotary
Winkler County	63	59	32	70	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	45	44	5	39	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	19	19	2	14	6450-6682	3	39	Rotary
Fitts Pool	51	47	7	54	1800-4488	2 or 3	38	Rotary
Osage County	22	15	5	24	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
McPherson County	8	6	2	11	2900-4300	2	38	Rot.-Cab.
Russell County	38	35	9	58	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	42	38	11	57	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	24	21	7	31	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas								
Rodessa	25	25	7	50	5950-6450	3	39	Rotary
New Mexico								
Lea County	69	66	20	113	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	3	3	3	15	8300-8730	3 or 4	40	Rotary
Wilmington	41	41	50	63	3500-4000	2 and 3	18-20	Rotary
Midway-Sunset	13	13	9	19	1400-3100	1 and 2	11-30	Rot.-Cab.

Field Activities by States for May, 1937

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1936 (In Barrels)
	May	April	May	April	May	April	May	April	May	April	
Arkansas	8	13	3	4	17	24	14	12	53	48	10,461,000
California	128	141	104	123	191	177	137	135	273	276	214,883,000
Colorado	....	1	....	0	....	....	2	1	29	28	1,670,000
Illinois	....	9	....	5	....	....	....	39*	....	18	4,452,000
Indiana	1	11	0	5	....	....	9	7	43	39	795,000
Kansas	227	255	176	200	355	315	99	78	497	392	58,226,000
Kentucky	19	10	14	6	....	....	31	30	72	70	5,653,000
Louisiana	86	71	63	53	222	121	65	43	334	224	79,980,000
Michigan	96	65	73	48	110	103	114	108	154	146	11,852,000
Mississippi	....	1	....	0	....	....	5	5	12	10	Gas Prod.
Montana	19	15	17	14	....	....	9	8	54	50	5,632,000
New Mexico	69	62	67	62	....	....	23	17	141	124	27,134,000
New York	....	....	....	....	....	....	6	7	41	51	4,637,000
Ohio	93	107	70	72	....	....	92	91	270	265	3,834,000
Oklahoma	337	317	249	237	283	351	78	72	541	501	206,082,000
Pennsylvania	....	....	....	....	....	....	....	40	....	163	15,830,000
Texas	1342	1503	1053	1177	2171	1709	641	461	2157	1527	391,097,000
West Virginia	74	78	60	63	....	....	25	24	155	151	3,903,000
Wyoming	11	11	8	7	....	....	10	4	54	51	13,650,000
Total	2509	2670	1957	2076	3449	2800	1360	1182	4880	4134	993,942,000

*Includes nine operations rigging up, 25 temporarily shut down, and five inactive.



Shown is a typical traffic jam on the Allegheny River at the mouth of Oil Creek in the early 60's. In the effort to get oil to market, boats, barges and rafts were loaded with crude oil — dams were opened to create a rush of water — often resulting in loss of cargoes and life. It is estimated that over 1,000,000 barrels of oil were lost in this frenzied effort to ship oil.

Dependent on plodding teams and sluggish barges, early oil producers struggled frantically to serve their customers. Progress has changed all that. For example, Dowell is particularly proud of its transportation equipment and service. Its fleet of fast trucks and cars goes anywhere—any time. To date, in treating over 9,000 wells, Dowell equipment has travelled over 4,500,000 miles and transported Dowell *Inhibited* Acid totalling millions of gallons.

ATTENTION DRILLING CONTRACTORS

Dowell's latest advance—Dowell Inhibited Heavy Acid—assures greater efficiency in loosening stuck drill pipe. Acid heavier than drilling mud is, in many cases, essential for successful freeing of pipe stuck at the bottom of the hole. Write to any Dowell station for The Acidizer, "Loosening Stuck Drill Pipe."

* **DOWELL**

*Trade Mark Registered U. S. Patent Office

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OIL AND GAS WELL CHEMICAL SERVICE

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 77.1 Percent **Central Division, 81.8 Percent** **Eastern Division, 88.2 Percent**

A $1,000,000 expansion program is under way at the Ethyl-Dow Chemical Company's plant for the recovery of bromine from the sea at Kure Beach, near Wilmington, North Carolina. Capacity will be doubled, and the annual output of ethylene dibromide increased to 20,000,000 pounds. Ethylene dibromide, which is 85 per cent bromine, is added to tetraethyl lead, the anti-knock factor, to be mixed with gasoline.

●

Five 180-hp. compressors are being added to the equipment of J. E. Crosbie, Inc.'s natural gasoline plant in the Fitts pool, Pontotoc County, Oklahoma. The capacity of the plant will be increased to 20,000,000 cu. ft. daily.

●

The Johnson Oil Refining Company's plant at Cleveland, Oklahoma, has been enlarged by the addition of a new Dubbs cracking unit having a capacity of 2500 bbl. daily. The plant is operated under the Dubbs patent and the engineering work was under the supervision of the Universal Oil Products Company. The company's engineering department directed all construction work, except installation of the two furnaces, which were under contract to Frick-Reid Supply Corporation. The Tulsa Boiler and Machinery Company manufactured the stabilization equipment and the main fractionating tower. Hot oil pumps and Diesel engines were by Worthington Pump and Machinery Corporation; and instruments by Leeds and Northrup and the Taylor Instrument Companies.

●

The Phillips Petroleum Company has under construction a natural gasoline plant in the Goldsmith field of Ector County, Texas. A polymerization unit probably will be installed, it is announced.

●

The Gulf Oil Corporation plans to add an iso-octane unit to its Port Arthur, Texas, refinery, to be constructed by The Lummus Company of New York City. Iso-butane will be manufactured by direct synthesis from di-isobutene. Capacity of the unit will be 2000-bbl. of raw stock daily.

The casinghead gasoline plant under construction in the Cayuga field of Texas by C. S. Middleton and others will be completed the latter part of June, it is announced. Capacity of the plant will be 10,000,000 cu. ft. daily. This will be the first gasoline plant situated in the field proper. The Lone Star Gas Company processes gas from the field, but their plant is at Trinidad on their main line to Dallas.

●

According to a recent announcement construction of the Ethyl Gasoline Corporation and E. I. DuPont de Nemours and Company's $3,000,000 plant for manufacturing anti-knock compound at Baton Rouge, Louisiana, will not begin until September 1.

●

The Talco Refining Company will erect in the Talco field of Texas a 3000-bbl. capacity refinery, costing approximately $10,000. The distillation unit will be 2-stage, one unit being atmospheric, the other vacuum. C. B. Davis will be in charge of construction work.

●

A new Ethyl blending plant recently was completed at the Pampa, Texas, refinery of the Danciger Oil and Refining Company.

●

The Bradford Oil Refining Company, Bradford, Pennsylvania, has awarded a contract to The Lummus Company for the construction of an acetone-benzol solvent dewaxing plant of 600-bbl. capacity. The Texaco Development Company has issued a license to the Bradford refinery for use of the process. The unit is expected to be completed the latter part of this year.

●

The Pure Oil Company will spend approximately $2,000,000 on its refinery at Smiths Bluff, Texas, it is reported. The expansion program is expected to get under way some time this summer. A new combination unit and a skimming unit recently were added to the refinery's equipment.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks

Week Ended May 29, 1937

A.P.I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.1	551,000	82.4	18,976	6,648
Appalachian	88.4	110,000	85.3	2,857	636
Ind., Ill., Ky.	92.1	453,000	97.0	13,842	5,009
Okla., Kans., Mo.	84.6	289,000	76.1	8,783	3,039
Inland Texas	56.6	153,000	76.1	1,967	1,504
Texas Gulf	95.5	707,000	93.4	10,384	6,662
La. Gulf	96.3	144,000	91.1	1,375	1,995
No. La.-Ark.	63.7	42,000	72.4	441	362
Rocky Mt.	69.7	54,000	87.1	2,028	748
California	90.9	501,000	67.2	14,293	67,363
Reported	88.8	3,004,000	82.8	74,946	93,966
Est'd Unreported		241,000		4,552	2,257
*EST'D TOTAL U. S. May 29, '37		3,245,000		79,498	96,223
*EST'D TOTAL U. S. May 22, '37		3,290,000		79,827	95,111
U. S. B. of M. *May 29, ,1936		**2,924,000		71,728	101,722

*Estimated Bureau of Mines' basis.

**May, 1936, daily average.

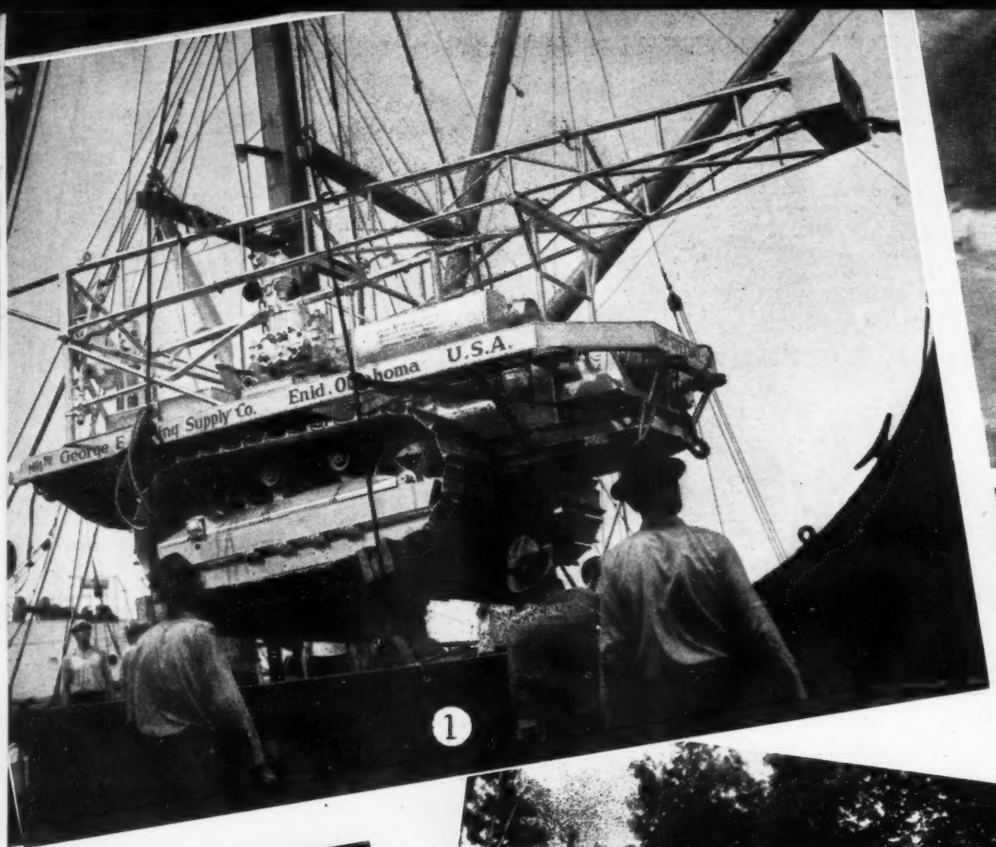
Pictorial PETROLEUM

JUNE, 1937

A REGULAR FEATURE OF THE PETROLEUM ENGINEER

1839 - 1937

John D. Rockefeller



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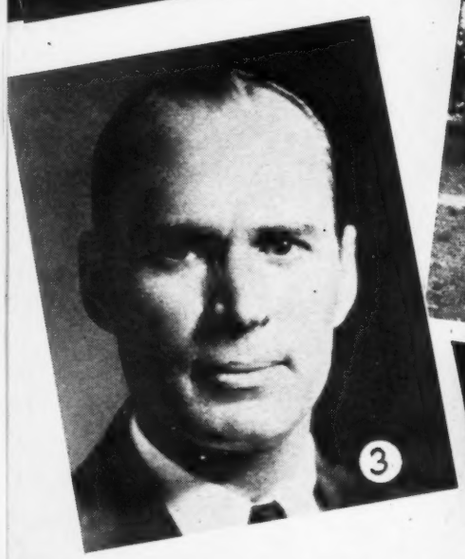

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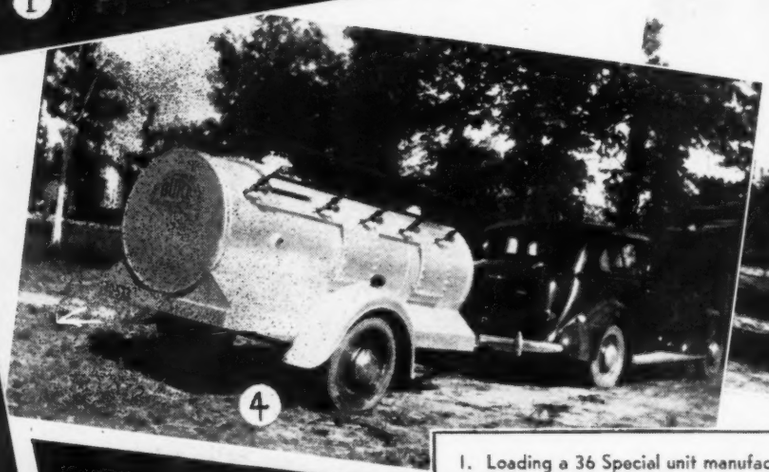


4

5

1. Loading a 36 Special unit manufactured by George E. Failing Supply Co., Enid, Oklahoma, for shipment to the Texas Petroleum Company in Colombia, South America.

2. Although the manufacturers assure us that a Lufkin pumping unit never "laid an egg", an industrious hen in East Texas had laid one in the base of this Lufkin unit for four consecutive days when this photograph was taken. Photograph courtesy E. M. Burt.

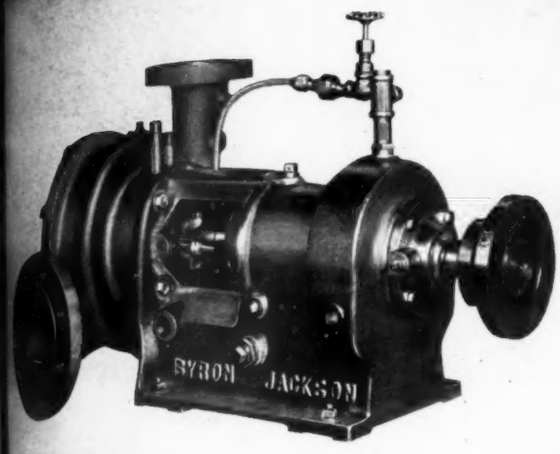
3. C. R. Athy, chief engineer of International Derrick & Equipment Company.

4. Testing model of the Burt "haytank", manufactured by Burt Tank, Separator & Oil Treating Corporation, Wichita Falls, Texas.

5. A Burt treating tank on the Hawkeye Petroleum Company's lease at Livingston, Texas.

6. Office of the John Zink Company, Tulsa, Oklahoma. (Inset) John Zink, president, showing how it is done with mirrors.

6



CORRECT DESIGN FOR EACH FIELD

Low Capacity

Low and Medium Heads
15 to 800 GALLONS PER MINUTE

SINGLE STAGE SINGLE SUCTION PUMP

- Maximum simplicity.
- Affords maximum possible clear openings through waterways.
- No bearings to remove in dismantling pump.
- Concentric support on centerline permits expansion without misalignment.
- Case and cover sealed by single circular gasket in recessed seat.
- Nozzles cast integral with case permit disassembly without disturbing piping.
- Nozzle arrangement is vertical, providing for simple piping and eliminating vapor binding in the suction.
- One stuffing box under slight pressure even on vacuum service.
- Low bearing loads due to pressure equalization on back of impellers by radial ribs.
- Field of application: 15 to 800 gallons per minute at temperatures up to 800 degrees F., against heads of 75 to 400 feet.

Complete information on all Byron Jackson Pumps will be sent on request.

Since 1872

BYRON JACKSON CO.
and subsidiary
Factories at: Berkeley and Los Angeles, California
Bethlehem, Pennsylvania
Sales offices: New York, Salt Lake City, Fort Worth.

High Capacity

Low and Medium Heads
800 TO 3000 GALLONS PER MINUTE

SINGLE STAGE DOUBLE SUCTION PUMP

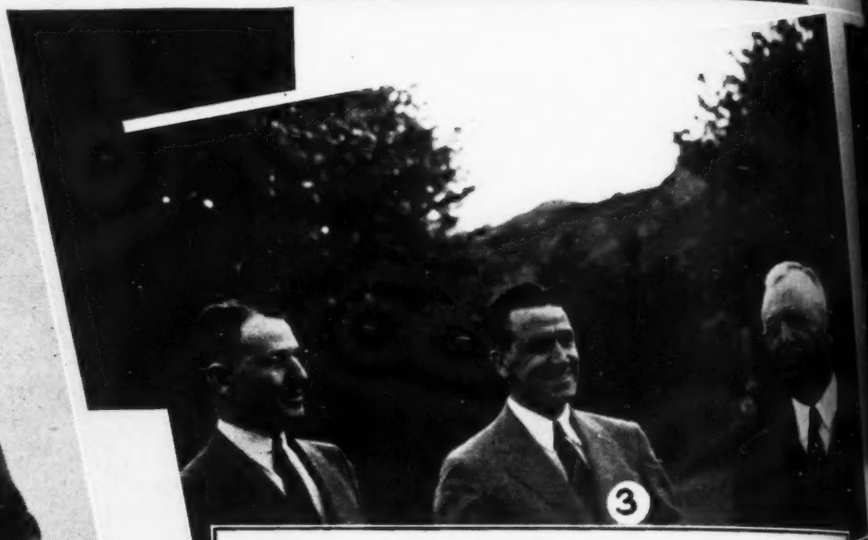
- Center support under nozzles eliminates pipe strains with consequent misalignment at high temperatures.
- Case and cover sealed by two circular gaskets in recessed seats, only one of which is broken to dismantle pump.
- Nozzles cast integral with case permit disassembly without disturbing piping.
- Nozzle arrangement is vertical, providing for simple piping and eliminating vapor binding in the suction.
- Two stuffing boxes at suction pressure.
- Negligible bearing loads.
- Field of application: 800 to 3000 gallons per minute, at temperatures up to 800 degrees F., against heads of 250 to 800 feet.

BYRON JACKSON

CENTRIFUGAL PUMPS FOR EVERY SERVICE

Candid Camera Shots
Taken at the Midyear Meeting of the A.P.I., Colorado Springs, June 1 to 3

Photographs courtesy of G. Raymond, chief engineer, Black, Sivalls & Bryson, Inc., Oklahoma City, Oklahoma, who did the camera work.



1. Exceptional camera study of one amateur photographer by another. The subject is George Bays of the Stanolind Oil & Gas Company, Tulsa, Oklahoma.

2. H. C. Boardman of Chicago Bridge & Iron Works.

3. While the photographer did not learn the name of the gentleman on the left, the man in the center is Charles Dunlap of Humble Oil & Refining Company, and the one on the right is C. B. Edwards, Houston representative for Lufkin Foundry & Machine Company.

4. Palatial residence of Mr. Spencer Penrose, who entertained with a tea and cocktail party for the A.P.I. members and guests. (Inset) Mr. and Mrs. Spencer Penrose.

5. Taken at the main banquet were O. D. Donnell, president, Ohio Oil Company, and Carl Young, secretary of Division of Production of American Petroleum Institute.

6. Having their coffee in the foreground are (left to right): John Tancred, Jr., Dallas representative of Crane Co.; Don Sillers of Lone Star Gas Company; Elmer F. Schmidt, Lone Star Gas Company, and Howard Pape of Crane Company.

7. W. K. Whiteford, vice-president, British American Oil Company, Tulsa, Oklahoma.

8. H. M. Staggs, engineer with Atlantic Oil Producing Company, Dallas, Texas.

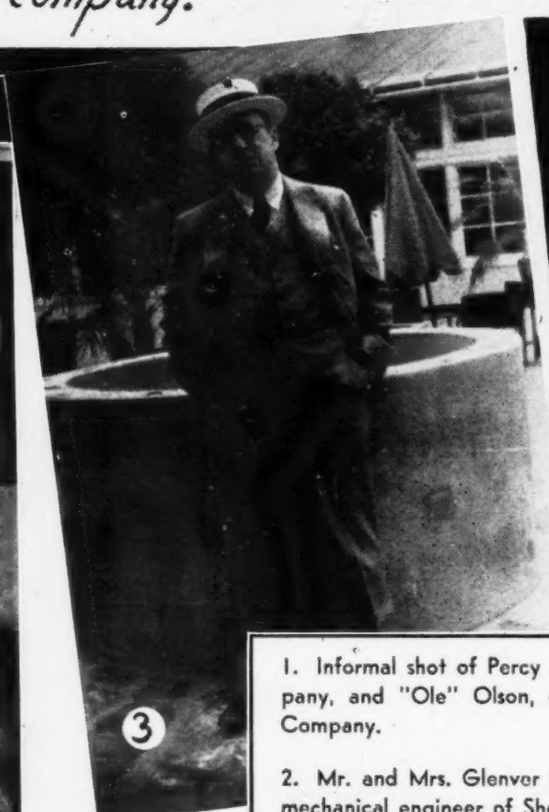
9. Enjoying the banquet also were (left to right): Don Knowlton, engineer with Phillips Petroleum Company; second man unknown to us; D. A. Sykes of Baroid Sales Company; Tom Hamilton, Phillips Petroleum Company; George Bays of Stanolind Oil & Gas Company, and in the right foreground, D. K. Hutchcraft, of Clark Bros. Company.

10. Grouped informally at the edge of the Broadmoor Hotel Lake are (left to right): Walter Trout of Lufkin Foundry & Machine Company, Harry Dunlap of Humble Oil & Refining Company, "Buck" Morris of The Texas Engineering Association, and C. B. Edwards of Lufkin Foundry & Machine Company. The gentleman with his back turned is undistinguishable.

Candid Camera Shots

Taken at the Midyear Meeting of the A.P.I., Colorado Springs, June 1 to 3

Photographs on these two pages by courtesy of Arch Campbell, representative at Tulsa, Oklahoma, for Waukesha Motor Company.



1. Informal shot of Percy Jones, president of S. M. Jones Company, and "Ole" Olson, chief engineer of Continental Supply Company.

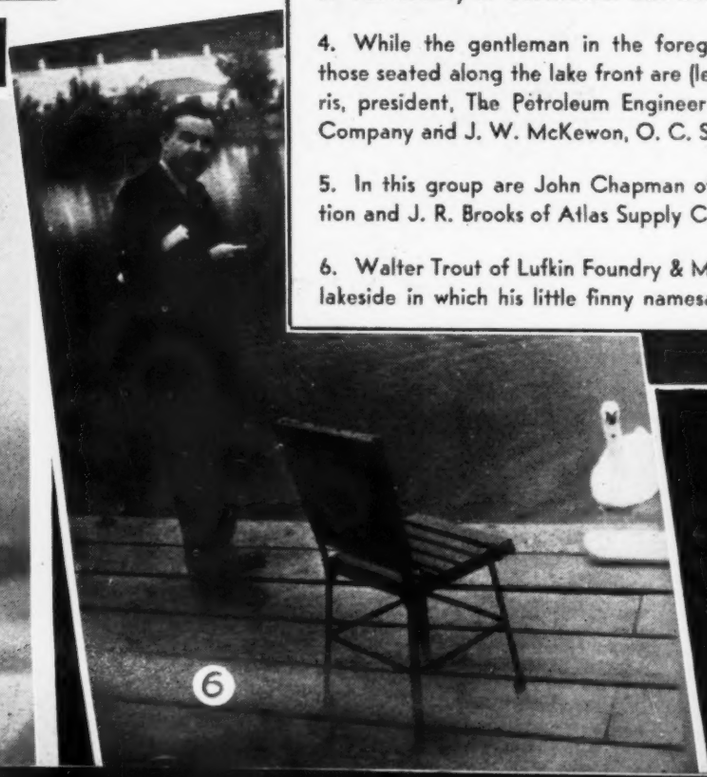
2. Mr. and Mrs. Glenver McConnel. Mr. McConnel is divisional mechanical engineer of Shell Petroleum Company at Tulsa.

3. Pat Rooney of Continental Can Company.

4. While the gentleman in the foreground is undistinguishable, those seated along the lake front are (left to right): Clarence Morris, president, The Petroleum Engineer; Dave Trax of Gypsy Oil Company and J. W. McKewon, O. C. S. Manufacturing Company.

5. In this group are John Chapman of Lucey Products Corporation and J. R. Brooks of Atlas Supply Company "feeding the fish."

6. Walter Trout of Lufkin Foundry & Machine Company along the lakeside in which his little finny namesakes are so plentiful.



7. Roy Dow (left) and Bob Bradshaw, both with International Supply Company, Tulsa, Oklahoma.

8. Henry Koopman, vice-president of Phillips Petroleum Company.

9. George Bays of the Stanolind is having trouble with his Leica. Doug Brown of O.C.S. Manufacturing Company is to be seen on the boardwalk.

10. Pat Rooney of Continental Can Company is telling Harry Potts of Kerotest Manufacturing Company a hot one. Eb Isaacs, Houston representative of Gray-Kerotest, listens in.

11. John Chapman of Lucey Products Corporation.

12. Joe Mahan (left) and Edward Timbs, both with The National Supply Company.

13. Distinguishable in this picture are Charles Weiss (left), chief engineer of Link-Belt Company, and Hu Harris of Humble Oil & Refining Company.

A resume of the benefits to be derived from Petreco Electromatic Dehydration shows important advantages and savings all along the line — from the well through the refinery. These advantages and savings accrue to all departments of both large and small operating companies, whether they transport and refine their own crudes or not; and are sufficient to assure desirable profits over and above the low treating cost.

Producers, pipe line operators, and refiners, all are urged to check their crudes carefully for water content, as well as the savings and added profits available through complete dehydration of all wet oil. Petreco engineers, field men, and laboratory technicians are available for this purpose at all times without cost or obligation.

PETROLEUM RECTIFYING COMPANY OF CALIFORNIA

General Offices: 530 West Sixth Street, Los Angeles, California

Branch Office: Houston, Texas. Branches and Service Men In Principal Oil Fields.

PETRECO

THE Petroleum Engineer

JUNE, 1937

Burning Well Now is Normal Producer

Burning fiercely for ten days, well was successfully brought under control within twelve hours after snuffing out fire with explosives and eventually completed as normal oil well with the original casinghead and casing still intact

By K. C. SCLATER

A DRILLING well that catches fire and burns fiercely for more than ten days without becoming a total loss, but instead comes through with the casing and casinghead intact, is worthy of more than passing note.

Such a well is the Continental Oil Company's State No. 1-C-16 in the Monument field, Lea County, New Mexico. The well recently was completed and brought in as a normal well producing at the rate of 15 bbl. of oil an hr. and 500,000 cu. ft. of gas daily through a ¾-in. choke. Why this well did not suffer the fate of so many others was due largely to the efficient way the well was handled in a grave emergency.

Three main factors contributed to bringing the well successfully under control after it had blown out and caught fire: first, the expert judgment and care exercised in handling and placing the explosives that eventually snuffed out the fire; second, the efficient method employed in setting the casings and tying them in at the surface; and last but not least, the innovation of shutting off the well several hundred feet below the surface in the inner string of casing by means of a removable casing plug. Shutting off the well in this manner made it possible to inspect the casing and casinghead connections at the surface and to make repairs or replacements with comparative safety were any such required.

The well was being drilled with a modern Diesel rotary rig and had reached a depth of 3809 feet. A string of 5½-in. casing had been set and cemented at about 3700 feet. There was also a string of 7⅝-in. and one of

In this issue *The Petroleum Engineer* introduces a new feature—one that it is believed will meet with enthusiastic response from all those connected with the petroleum industry in an operating capacity. On page 123 appears the first installment of THE PETROLEUM ENGINEER'S CONTINUOUS TABLES, compiled especially for office and field engineers, field and plant men, and others who may have need of such practical operating data. This will be a regular monthly feature of *The Petroleum Engineer*.

Shortly after well caught fire. Note tank on left about to ignite

After tank on left caught fire clouds of black smoke rose from the burning oil

Above—Picture of fire at its height taken through window of automobile

Below—Tank and its contents in full blaze.
Note part of the remains of steel derrick outlined against flame

10¾-in. casing in the well. The pay, a hard limestone, had been penetrated about ten ft. and was carrying mostly gas at an estimated pressure of 1175 lb. per sq. inch. As a safety and also a conservation measure the well was being drilled-in under pressure control with 3½-in. flush joint drill pipe and was equipped with Otis pressure control equipment, consisting of a snubbing device and lubricator with upper and lower blow-out preventers. The well had a round concrete cellar about eight ft. in diameter and some six to eight feet deep. The top of the cellar was approximately level with the surface of the ground. An 8-ft. steel substructure extended from the ground to the derrick floor. The upper blow-out preventer for snubbing in drill pipe under pressure was at a convenient working level above the derrick floor; similarly, the lower blow-out preventer was at a convenient working level above the surface of the ground. The flanged Rectorhead securing the casing at the surface was in the cellar.

The foregoing describes briefly and approximately the status of the well and equipment when on April 15 about 8 a. m. the well blew out and caught fire. The drill pipe had been pulled to change the bit and was being run back in. Five stands of drill pipe were in the hole when the well suddenly blew out without warning. It seemed only a matter of seconds before the well caught fire, a violent explosion occurring when the gas ignited. Almost immediately the well became an inferno. The flow of oil and gas fed the flames, which in a short time reduced the derrick and machinery to a twisted mass of metal.

The following day, Friday, the Kinley Brothers, Myron M. and Floyd T., arrived on the scene and immediately began making deliberate preparations to extinguish the blaze and bring the well under control. By Saturday, water lines had been laid and preparations completed for placing a shot of explosives to blow the snubbing equipment and upper blow-out preventer off the casing. Owing to the obstruction caused by the snubbing equipment and also the twisted mass of steel that had fallen beside the casing there was a veritable spray of fire (see accompanying photographs of the fire) that spread the blaze over a large area. Before any attempt could be made to clear away the mass of twisted steel, the blaze first had to be confined to a smaller area. A 30-qt. shot of gelatin was applied at the top of the casing. This blew off the snubbing device, including the upper blow-out preventer. Immediately the well pressure ejected

the five stands (approximately 400 ft.) of drill pipe from the well and hurled it straight into the air. Thus the inside of the 5½-in. casing at least was cleared of obstructions. A plug in the side outlet of the lower blow-out preventer also was carried away and caused another spray of flame to shoot outward along the ground.

A small 10-qt. shot was then used to blow off the lower blow-out preventer; it also blew off the master gate valve below the preventer. This almost confined the fire to a gigantic torch shooting straight up from the casing. The effect of these shots are illustrated in sequence in the accompanying photographs.

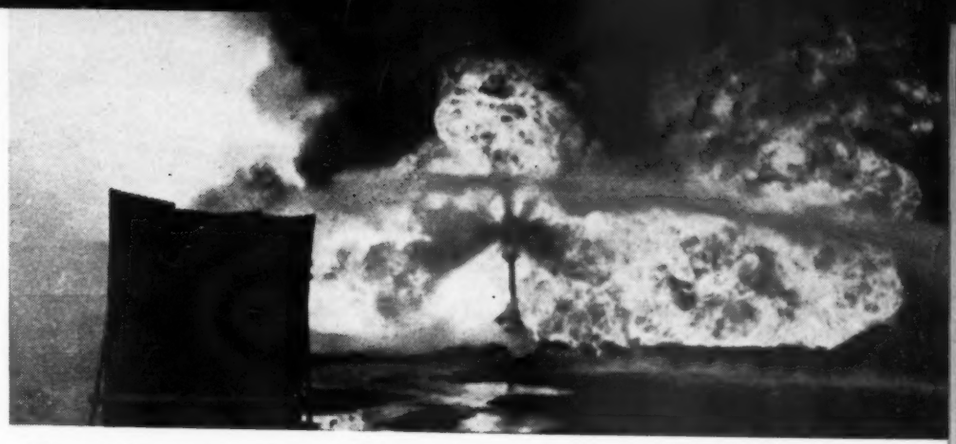
Within two days after setting off the 10-qt. shot most of the debris had been cleared away from the immediate vicinity of the casing and on Wednesday, April 21, a 40-qt. shot was set off in a first but unsuccessful attempt to snuff out the fire. On the following day an 85-qt. shot was tried, but this also was unsuccessful, despite the fact that this shot was one of record size employed for snuffing out a well fire. The high pressure and velocity of the flow from the well may have had something to do with the futile results obtained in these first two attempts.

Undismayed, M. M. Kinley on the following day, Friday, April 23, placed a triple shot containing 155 qts. of explosive, and consisting of two 40-qt. shots and one 75-qt. shot. These were set off simultaneously by electrical means. The original method employed in placing these shots is interesting.

A two-wheeled metal carriage was constructed on which was mounted a drum containing the shot. The container holding the explosive was jacketed with a 3-in. thickness of asbestos and placed in the drum. Two arms extending forward on each side of the drum can be observed in one of the accompanying photographs. These were for guiding the placement of the shot toward the casing. In the photograph only one drum for a single shot is shown on the carriage.

For the placement of the triple shot, a frame of horseshoe shape was made and two of the drums placed on the ends and the third in the center of the frame of the horseshoe. The carriage was wheeled into position so that the three shots were about equi-distant from the casing.

The carriage on which the drums and frame were mounted were counterweighted for ease in handling. The wheels of the carriage rolled in a track, which was about 40 ft. long and made from 4-in. pipe split lengthwise. This arrangement was a great facility in ac-

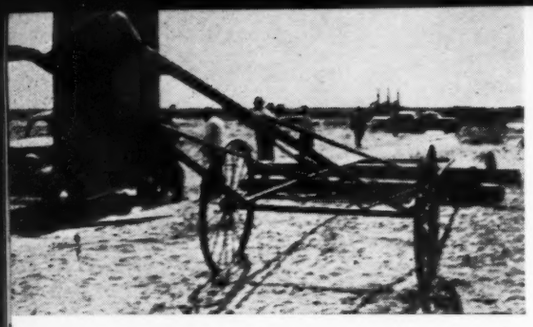


The snubbing connections on casing deflected the flow of oil and gas and spread the fire

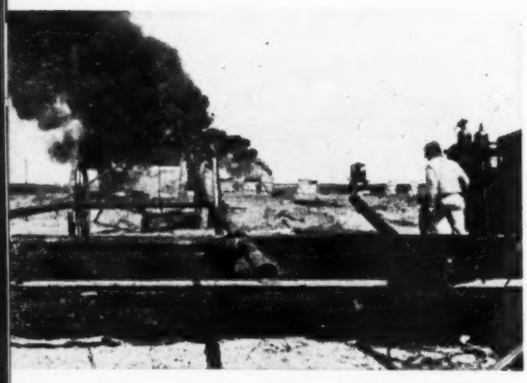
After snubbing connections and upper blowout preventer were shot off with high explosive. Note twisted drill pipe ejected from hole

Above—After lower blowout preventer and gate valve were shot off casing with explosive

Below—Track for carriage carrying the explosive ready to be moved into position at the well



Front view of carriage constructed for placing shot. Explosive is in an asbestos-lined container inside drum. Note arms on drums for guiding shot on casing



Above—Back view of carriage with drum containing explosive. Drum is counterweighted for ease in handling

Below—All fire-fighting activities at the well were directed personally by M. M. Kinley on crutches

curately and quickly placing the shots in position. When ready to place the shot, the track was pushed into position close to the well, and the carriage rolled along in the track to the desired point. Both the carriage and track are shown in the accompanying photographs.

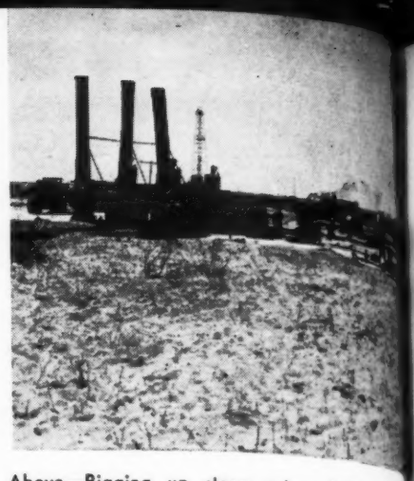
After the fire was extinguished the well was successfully brought under control and shut-in less than twelve hours later. The upper flange of the 7⅝-in. by 5½-in. Rectorhead was removed and replaced with a larger Rector flange and an adapter gland to fit over the Rector coupling on top of the lower flange. This upper flange and adapter gland was surmounted by a 9⅝-in. master gate valve and above it a 9⅝-in. nipple about six ft. long. Toggles for wire lines were attached to the top of the nipple to facilitate pulling the upper flange down on the lower flange while the well was flowing. After tightening the bolts in the flange the gate valve was closed, shutting the well in.

After the well was shut in at the gate valve, an Otis removable casing plug was run under pressure into the 5½-in. casing and set at 2260 feet. This effectively shut off the well at this point and allowed opening the gate valve above the Rectorhead to make an examination. As an added precaution the 5½-in. casing above the plug was filled with water to reduce the differential pressure between the bottom and top of the plug. With the exception of slight damage to the upper half of the 5½-in. coupling in the Rectorhead, both the 5½-in. and 7⅝-in. casings and also the casinghead were intact. The fact that the casinghead was of hammer-forged steel accounts for its freedom from damage by the explosives. When the casinghead and casing were found to be in good condition the removable casing plug was released and pulled under pressure.

A string of 2-in. tubing was then run under pressure to the bottom of the hole and an attempt made to produce the well. The well made almost all gas through a ¾-in. choke; the effort to produce oil in quantity was unsuccessful. Plans then were made to deepen the well. A steam rotary drilling rig was moved in and the well deepened 21 feet. The porosity and saturation were found to be satisfactory, and the well was completed at this depth. A string of 2-in. tubing again was run in under pressure, this time with an anchor packer on bottom that was set at 3809 ft., leaving 21 ft. of open hole below the packer. The well was brought in the early part of June producing 360 bbl. of oil and 500,000 cu. ft. of gas daily.

Skillful handling has thus made a normal oil well out of a burning well that might have been a total loss.

The pictures of the burning well reproduced here were taken by Robert Miles, inventory engineer in the production department of the Continental Oil Company.



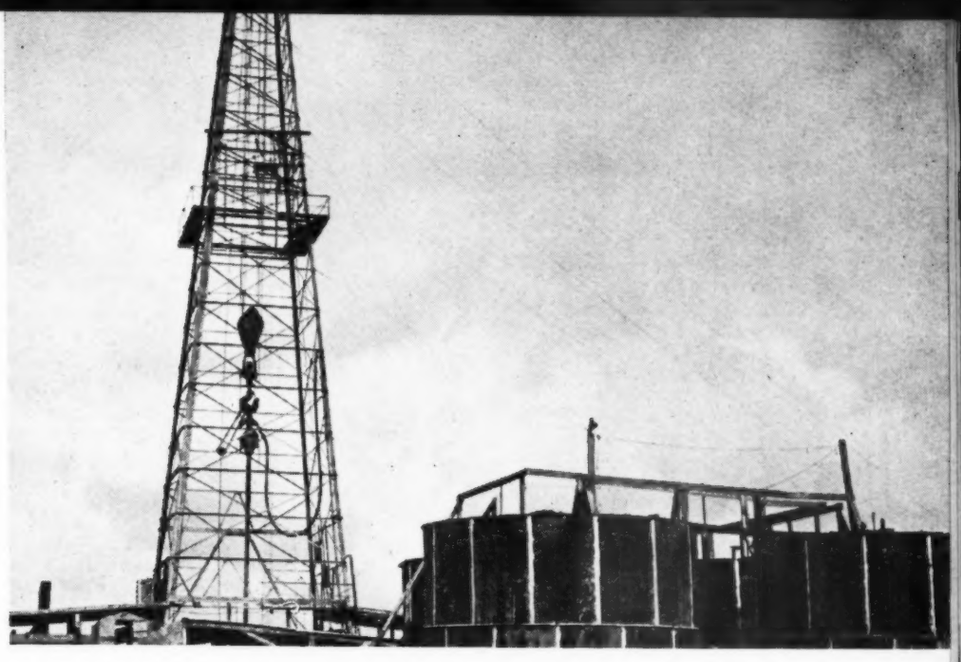
Above—Rigging up steam rotary drilling equipment to deepen after the well was brought under control

Below—Otis removable casing plug set in 5½-in. casing at 2260 ft. to shut-in well while making new casinghead connections. Pulling-out tool on left, running-in tool on right

THE PETROLEUM ENGINEER TO CONDUCT A REGISTRATION AT THE TULSA OIL SHOW

The Petroleum Engineer has completed plans for conducting a registration of all attendants at the International Petroleum Exposition to be held in Tulsa, Oklahoma, May 14 to 21, 1938.

Though full details have not yet been completed, plans will include presenting each visitor with a badge by means of which the branch of the industry in which he is engaged will be readily apparent. Complete details will be announced later.



View of rig with mud storage tanks in the right foreground

By DENIS S. SNEIGR

Gulf Coast Deep Tests Drilled Through Heaving Shale

Proper conditioning of mud and use of heavy drilling equipment important factors in solving the problem of heaving shale in Matagorda County, Texas

USING one of the largest and most elaborate rigs on record, the Continental Oil Company of Delaware recently completed one difficult deep test, and, using the same set-up, is nearing the contract depth of a second and equally difficult well.

Both of these tests are in areas noted for their heaving shale, Citrus Grove and Sheppards Mott in Matagorda County, Texas. The first well was the No. 2 Robbins at Citrus Grove. The well currently drilling is the No. 2 Hawkins on Sheppards Mott.

The rig used to drill both wells consists of two engines, two drawworks, three mud pumps, five boilers, four mud storage tanks, and a battery of small open tanks for suction pits. The hook, swivel, and block all are 300-ton test. Every piece of drilling equipment is the heaviest available. The various items of equipment are as follows:

Five boilers, 125-hp., 300-lb. working pressure.

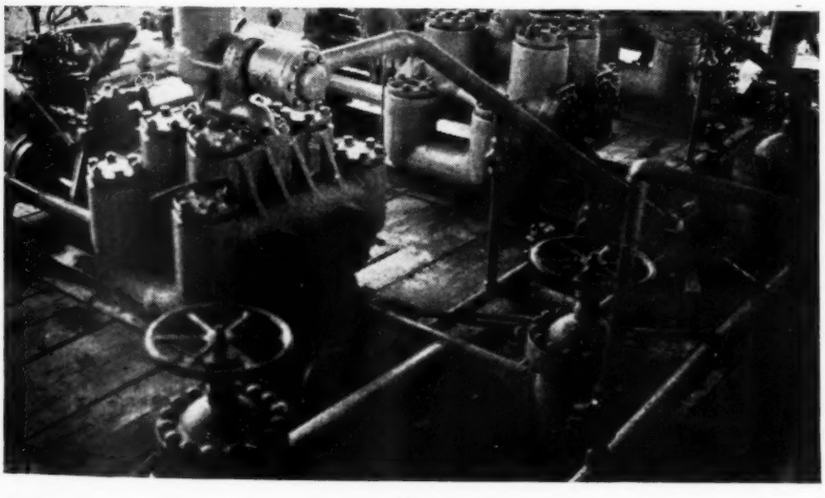
Two mud pumps, 15½ by 8½ by 20-in.

One mud-pump, 14½ by 7½ by 18-in.

Two engines, 14 by 14-in., twin-cylinder.

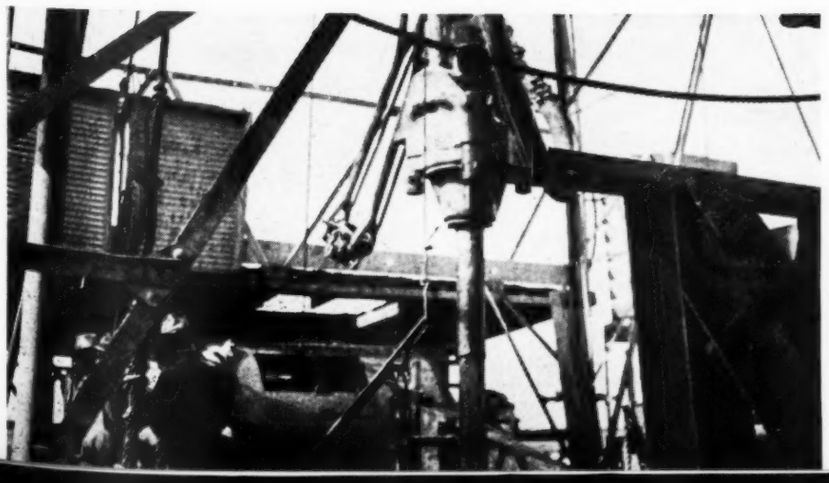
Two drawworks.

Three 1000-bbl. mud storage tanks.



View showing slush pumps and connections

One 500-bbl. mud storage tank.
Five 200-bbl. suction pit tanks.
Four 500-bbl. fuel oil tanks.



On the derrick floor. At the right is shown the swivel in the rat-hole

Under the derrick floor. Shown are the 26-in. casing, and the drilling gate valve with remote control

Two 1000-bbl. water tanks.

The layout of this rig is arranged for the most efficient operation possible. To the west of the derrick are the pumps, the suction tanks, and the mud storage tanks—arranged in that order. A corrugated-iron building houses the three pumps and the five suction tanks with additional space for tools and four carloads of sacked drilling mud. North of the derrick are the pipe racks for casing and east of the derrick is the battery of five boilers.

The 136-ft. steel derrick is mounted 14 ft. above the surface of the ground on a steel and concrete substructure. The cellar is 10 ft. deep. The derrick floor is approximately four times as large as the average derrick floor. This estimate includes the engine floors. Conveniently situated stairways and cat walks make the various units of the rig easily available from the derrick floor.

Employing this rig, the Continental Oil Company spudded No. 2 Robbins at Citrus Grove on December 8, 1936. Drilling was completed May 13, 1937.

Surface casing set in the hole consists of one joint of 26-in. O. D. casing, 235 ft. of 20-in. casing, and 2986 ft., of 16-in. casing. From 2986 ft. the hole was drilled to a depth of 6430 ft. using an unweighted sodium nitrate-sodium chloride drilling mud having a viscosity of 29 and a weight of 12.5 lb. per gallon.

At 6430 ft. the top of the heaving shale was encountered and the 11¾-in. casing was set. At this point, weighting material was added to the mud, bringing the viscosity to 38, and the weight to between 15.7 and 16 lb. per gallon. Using this mud, a 10⅝-in. hole was drilled to 8908 ft. with 4½-in. drill pipe.

From 6430 ft. to 8908 ft., the 10⅝-in. hole was reamed to 13-in. diameter, using 8⅝-in. O. D. casing as drill stem. A collapsible bit was used and at the completion of the reaming the bit was fished out of the hole and the 8⅝-in. drill stem casing cemented at 8912 ft. with 1200 sacks of cement.

From 8912 ft. to 11,612 ft., the total depth of the No. 2 Robbins, 3½-in. O. D. drill pipe was used. The well still was in heaving shale when drilling was completed.

At this writing, the No. 2 Hawkins is down to about 5350 ft., where the Continental is preparing to set 11¾-in. casing. As a matter of interest, the casing programs of the two wells are given:

No. 2 Robbins—Citrus Grove

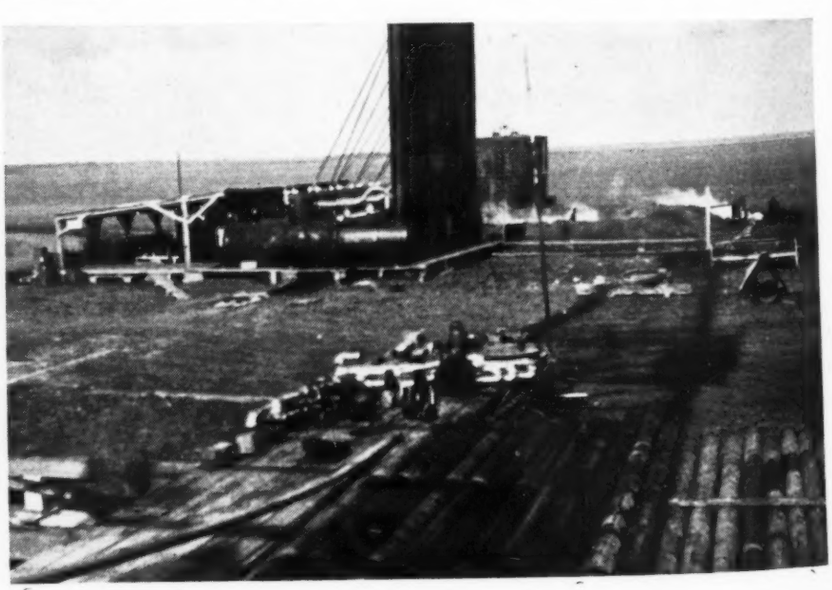
Casing	*Weight*	*Depth*
26-in.	(one joint)	30 ft.
20-in.	90 lb.	235 ft.
16-in.	84 lb.	2986 ft.
11¾-in.	61 lb.	6430 ft.
8⅝-in.	43.75 lb.	8912 ft.

No. 2 Hawkins—Sheppards Mott

Casing	*Weight*	*Depth*
26-in.	(one joint)	20 ft.
20-in.	84 & 90 lb.	118 ft.
16-in.	75 & 84 lb.	818 ft.
11¾-in.	61 lb.	5350 ft.

Although officials of the Continental Oil Company do not assert they have solved completely the heaving shale problem in Matagorda County, these two tests have pointed the way and have accomplished more in the direction of a successful solution of the heaving shale problem than anything done in the past.

To the drilling mud more than any other one factor is attributed the success of drilling the No. 2 Robbins. The Continental had three chemical engineers on the job, working in eight-hour shifts. A laboratory was set up at the well and here all data on the mud were compiled and all the necessary tests made. During the drilling of the Robbins well, the drilling mud was constantly under observation. Tests were made every 30 minutes for gel, viscosity, and weight. This same practice of paying close attention to the drilling mud is being followed on the No. 2 Hawkins and there three chemical engineers also are being kept on the job.



Five boilers, 125-hp., 300-lb. working pressure, are being used

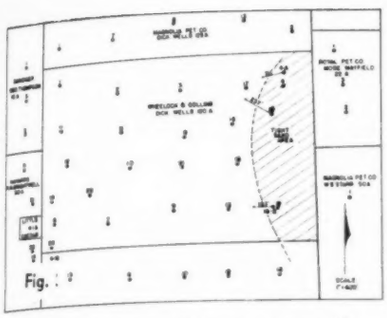


Fig. 1

Directional Drilling Applied to East Texas Edge Wells[1]

Drifting wells into the most permeable portions of the pay sand underlying the lease has proved to be profitable procedure

By JAS. D. HUGHES[2]

TIGHT or highly impermeable areas of slight saturation exist in productive sands. This fact is well known and appreciated by those connected with the drilling and development of oil properties. It is not an uncommon occurrence, particularly in East Texas, for a well to be drilled on a location surrounded by good producers yet upon penetrating the producing sand find it too tight or not having enough saturation even to make a small well. The object of this paper is not to discuss the geological and physical explanation of such occurrences, but to show how one operating company confronted with such a situation decided to do something about it and proceeded to apply controlled directional drilling as a solution. Contrary to prevailing general opinion, such operations can be conducted on a sufficiently low scale of expenditure to make the operation profitable, as will be evident from a study of the figures and data contained in this paper.

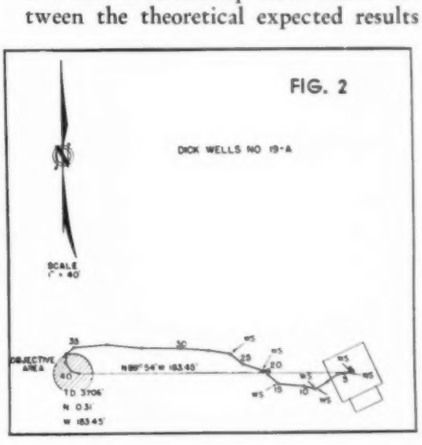
These operations were conducted by the Wheelock and Collins Oil Company on their 120-acre Dick Wells lease in the Kilgore area on the eastern edge of the East Texas field. A brief historical resume will serve to present the background and events leading up to the application of directional drilling. The first well on this lease was drilled in the northwest corner and completed on September 1, 1931, at a depth of 3700 feet. It is a good well, flowing 544 bbl. on the second hour of a potential test made June 2, 1933, and today, when opened to make its allowable, flows at the rate of 60 bbl. an hour through a 5/8-in. choke. Other locations were drilled on the south end of the lease, and then Well No. 4, as shown on the map in Fig. 1, was drilled in the northeast corner of the lease and completed November 1, 1931. The sand in this well differed from the sand in well No. 1, having much lower porosity and less saturation; the well could produce only 60 bbl. a day on the beam. The rate of production fell off rapidly until in March, 1937, it had declined to four bbl. a day and was abandoned. Well No. 19 later was drilled in the southeast corner of the lease. In this instance the hole was drilled to 3653 ft. and casing set, after which the well was completed with cable tools. When penetrated, the producing sand was found to be too tight and had insufficient saturation even to make a small well; so the hole was abandoned.

The results of the two wells drilled on the east edge of the lease were decidedly discouraging and led the operators to suspend action on a permit that had been obtained to drill No. 18 between these two wells. As a result of these observations the operators decided that the sand underlying the eastern end of their lease and indicated by the shaded area in Fig. 1, was too tight for commercial production.

In recent years much has been written and learned concerning the migration and drainage of oil and gas into a bore hole, and the influence of hole diameter and exposed superficial area upon the rate of entry. It is reasonable to assume that many a small well producing from so-called tight sands at a low rate might have its daily rate of production increased by increasing the superficial area of the pay sand exposed in the hole. There are two methods by which this objective might be reached: by increasing the diameter of the hole in the pay sand, or by penetrating a greater thickness of pay sand. In the latter case the number of feet of sand that can be obtained in ordinary drilling practice generally is limited by the thickness of the sand section. A practicable means of overcoming this limitation and increasing the superficial area of the pay sand in the hole is by directional drilling—by penetrating the sand at the desired angle necessary. If, for example, a well drilled vertically penetrated a 10-ft. section of sand, the same well, if drilled through the sand at an angle of 45 deg., would increase the penetration more than 14 ft., or approximately 41.5 percent. In this instance, however, the next line of wells to the west all were good producers, and from the operator's viewpoint it would be necessary only to deflect across the hypothetical limit shown by the broken line in Fig. 1 to attain more definite results at a much lower cost.

A new location consequently was made for No. 19A, 100 ft. west of the original well No. 19, and plans made to deflect the hole due west a distance of 175 to 200 feet. A light rotary rig was moved in and drilling began on February 14th. Eastman directional supervision began the next day at a depth of 100 ft. and stopped 11 days later at a depth of 3550 ft., at which point it was assured that the well would bottom within the desired area. Table I is a record of the whipstock settings used in accomplishing the results shown graphically in Fig. 2, the horizontal projection of the deflected hole, and in Fig. 3, the vertical projection in the plane of the desired direction.

In Table 1, the column headed "Single Shot" refers to the single-shot reading at the depth the whipstock was set, the first angle given being the angle of inclination and the bearing following the direction of the inclination. Under the column headed "Expected Results" is given the theoretical results that should obtain from setting the particular-sized whipstock used in the direction given in the last column headed "Setting" under the angular conditions of the hole at the depth of setting as given in the "Single Shot" column. Under the column headed "Actual Results" are listed the results of the single-shot survey made after drilling off the whipstock and reaming the rat-hole. It is interesting to note the close relationship that exists between the theoretical expected results



[1]Read before The National Oil Scouts Association of America Convention at Dallas, Texas, June 26, 1937.

[2]Vice President, Eastman Oil Well Survey Company, Dallas, Texas.

TABLE 1—WHIPSTOCK RECORD WELL NO. 19-A

WS	Depth	Single Shot	Expected Results	Actual Results	Setting
1	538		2° 00′ West	1° 15′ S43°W	WEST
2	555	1° 15′ S43°W	3° 45′ S78°W	3° 40′ S86°W	WEST
3	852	4° 15′ S58°W	4° 15′ S86°W	4° 00′ S70°W	N22°W
4	886	4° 00′ S70°W	4° 45′ N70°W	4° 00′ N70°W	N15°W
5	1356	0° 15′ N68°E	2° 30′ N60°W	3° 00′ N57°W	N60°W
6	1617	0° 20′ SOUTH	2° 30′ N80°W	3° 00′ N84°W	N70°W
7	1904	5° 25′ N55°W	6° 45′ N75°W	7° 00′ N74°W	S55°W

and those actually obtained, indicative of the overall efficiency of the removable whipstock as a directional tool.

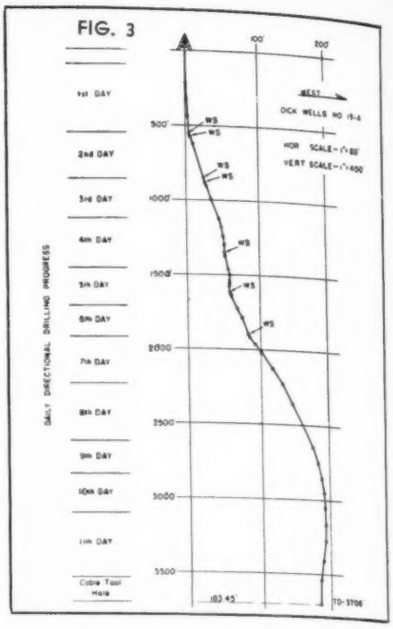
The horizontal projection of the deviated hole, as shown in Fig. 2, illustrates the course of the hole as it was guided to its objective and the points at which whipstocks were set. The companion vertical projection given in Fig. 3 illustrates the control over the drift angle in guiding the hole to its objective. The points at which whipstocks were set also is indicated, as well as the daily progress made under directional control.

The fact that the work was accomplished in the remarkably short time of 11 days, and that many doubtless would be interested in the distribution of the time consumed in the various phases of work, is sufficient justification for the inclusion of Table 2 showing a breakdown of the time during which the well was under directional supervision.

Additional interesting data are given in Table 3, entitled "General Data," from which it is seen that a daily average of 313.6 ft. of hole was drilled by these methods, considerably higher than has been obtained on similar jobs in other districts. An idea of the speed with which whipstocks were set and were drilled off can be gained from the fact that the total time consumed in seven settings was only 24.25 hr., or an average of 3.46 hr. a run.

Rotary drilling continued down to 3680 ft. and 5½-in. casing was set at 3660 feet. Cable tools were then moved in and the well completed at a total depth of 3706 ft. after taking in a well-saturated sand from 3698 ft. to 3706 feet. When turned into the tanks on March 5th, the well flowed at the rate of 35 bbl. an hour through 2-in. tubing at a flowing pressure of 50 pounds. Now, three months later, the well flows at the same rate and pressure. The total time consumed in completing this well was 19 days, including 72 hours time for cementing and miscellaneous shut-down time of 13¾ hours.

FIG. 3



The actual out-of-pocket cost of this well to the operators is itemized as follows:

There was no fuel or water expense, as the operators had ample of both on the lease; also because of the material available from salvage of well No. 19, the above costs are substantially lower than would have been the case had tubing, additional casing, and well-head assembly been purchased. Despite this, these costs are applicable to other operators under like circumstances, and offer a sound basis upon which to estimate similar operations.

The success and low cost of this first deviated well led the operators to obtain a permit for No. 4A to be drilled 100 ft. north of the old No. 4

TABLE 2—TIME DISTRIBUTION ON NO. 19-A DICK WELLS

DATE	A	B	C	D	E	F	G	H
2-15	9¾	¾	1¾			11¾	.....	.....
16	4¾	6	6	2¼	4½	½	.....	.....
17	9¾	6	2½	2	2¾	.....	.....	1
18	12¼	3½	6	¾	1½	.....	.....	.....
19	12¾	4	3½	1	2¾	.....	.....	.....
20	9	6¼	4½	¾	2	1½	.....	.....
21	20½	2	.....	.....	1½	.....	.....	.....
22	19	4	.....	.....	1	.....	.....	.....
23	21	2	.....	.....	1	.....	.....	.....
24	20	2½	.....	.....	1½	.....	.....	.....
25	20	3	.....	.....	1	.....	.....	.....
TOTAL	158¾	40	24¼	6¾	19½	13¾		1
	60.1%	15.1%	9.2%	2.6%	7.4%	5.2%	0.0%	0.4%

A—Drilling time. B—Trip time. C—Whipstocking time, orienting and drilling. D—Reaming time. E—Surveying time, single shot. F—Shut-down time. G—Circulating time. H—Follow-up run time.

TABLE 3—GENERAL DATA

	No. 19-A	No. 4-A	No. 18
Work Started	2-15-37	3-13-37	3-29-37
Work Stopped	2-25-37	3-23-37	4-7-37
Depth Started	100 ft.	538 ft.	608.00 ft.
Depth Stopped	3500 ft.	3528 ft.	3573.00 ft.
Elapsed Time	11 days	11 days	10 days
Total Hole Drilled	3450 ft.	3000 ft.	2965.00 ft.
Avg. Ft. per Day	313.6 ft.	272.7 ft.	296.50 ft.
Avg. Ft. per Hour	13.07 ft.	11.36 ft.	12.35 ft.
Avg. Ft. per Drlg. Hr.	20.77 ft.	22.54 ft.	21.53 ft.
Total Round Trips	29	23.5	17.50
Total Time Trips	40.00 hr.	49.00 hr.	30.25 hr.
Avg. Time per Trip	1.38 hr.	2.09 hr.	1.73 hr.
Total Whipstocks	7	5	4
Total WS Hole Drilled	132.00 ft.	93.00 ft.	80.00 ft.
Total Whipstock Time	24.25 hr.	37.00 hr.	28.75 hr.
Avg. Time per Run	3.46 hr.	7.40 hr.	7.19 hr.
Total Surveys Made	35	45	43
Total Time Required	19.50 hr.	23.00 hr.	23.00 hr.
Avg. Time per Survey	0.56 hr.	0.51 hr.	0.53 hr.
Total Hole Reamed	152.00 ft.	93.00 ft.	583.00 ft.
Total Time Required	6.75 hr.	5.50 hr.	5.00 hr.
Avg. Ft. per Hour	22.52 ft.	16.91 ft.	116.60 ft.
Total Circulating Time	0.00 hr.	9.50 hr.	10.00 hr.
Avg. Time per Day	0.00 hr.	0.86 hr.	1.00 hr.
Total Shut Down Time	13.75 hr.	11.00 hr.	9.00 hr.
Avg. Time per Day	1.25 hr.	1.00 hr.	0.90 hr.

FIG. 4

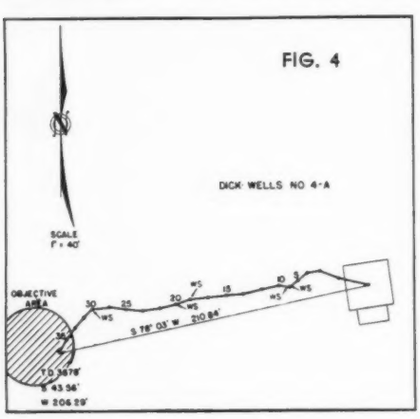


TABLE 4—WHIPSTOCK RECORD WELL NO. 4-A

WS	Depth	Single Shot	Expected Results	Actual Results	Setting
1	1308 ft.	2° 10′ S48°W	4° 20′ S74°W	3° 05′ S63°W	N87°W
2	1415 ft.	4° 00′ N70°W	5° 00′ S80°W	5° 30′ S80°W	S20°W
3	2097 ft.	3° 50′ S86°W	6° 00′ S68°W	4° 35′ S68°W	S46°W
4	2208 ft.	4° 35′ S68°W	7° 05′ S68°W	7° 30′ S76°W	S68°W
5	3064 ft.	1° 30′ S80°W	3° 40′S44°W	4° 45′ S37°W	S30°W

FIG. 5

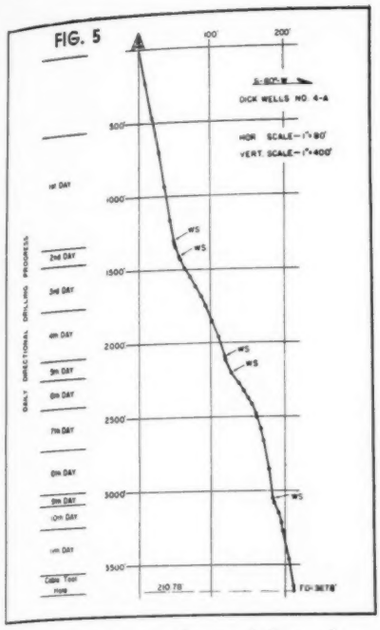


TABLE 5—TIME DISTRIBUTION—NO. 4-A DICK WELLS

Date	A	B	C	D	E	F	G	H
3-13	13½	½	5	.....	3	2	.....	.....
14	7½	4¾	8	1½	2¼	.....	.....	.....
15	14	4½	½	1	4	.....	.....	.....
16	14	3½	.....	.....	2½	4	.....	.....
17	6	6	9	¼	1½	1	.....	.....
18	8½	7½	3½	½	3	.....	1	.....
19	15	5¼	.....	.....	2¼	1½	.....	.....
20	24	.....	.....	.....	.....	.....	.....	.....
21	4	5½	4	.....	1½	2½	6½	.....
22	6½	5½	7	2	2	.....	1	.....
23	16	6	.....	.....	1	.....	1	.....
Total	129	49	37	5½	23	11	9½	....
Percent	48.8%	18.6%	14.0%	2.0%	8.7%	4.2%	3.6%	0.0%

A—Drilling time. B—Trip time. C—Whipstocking time, orienting and drilling. D—Reaming time. E—Surveying time, single shot. F—Shut-down time. G—Circulating time. H—Follow-up run time.

well. Plans were made to deflect the well to a point between 200 and 250 ft. in a direction S80°W of the surface location. The same rotary rig was moved in and drilling began on March 10th. Due to the difficulty experienced in controlling the angle in the soft upper formations in the previous hole, directional supervision was not begun on this well until March 13th and at a depth of 538 ft. and the setting of the first whipstock was delayed until a depth of 1308 ft. had been reached. As shown in Table 4 only five whipstock settings were necessary to deviate the well to its objective area.

An inspection of Table 4 reveals the consistent general efficiency of the whipstock as a control device. The horizontal projection of this deviated hole is given in Fig. 4, on which is traced the course of the hole as it was guided to the objective area, and also indicated are the points at which whipstocks were set. The vertical projection is shown in Fig. 5, together with the daily footage made under directional control and the points at which whipstocks were set. In viewing this last-mentioned plat, attention should be called to the gradual change in drift angles and the absolute absence of abrupt dog-legs that so often are the cause of twist-offs in drilling and later result in rod and tubing trouble when the well is put on the beam.

Directional supervision on this well stopped on March 23rd when the hole was at a depth of 3528 ft., after it was apparent that the hole would "bottom-up" within its objective area. Rotary drilling continued to the contract depth of 3657 ft. and casing was set at 3645 feet. Cable tools were moved in and the well completed at a total depth of 3678 ft. after taking in a well-saturated section of sand from 3661 ft. to 3674 feet. On March 30th, 20 days after the well was spudded, it was turned into the tanks and flowed at the rate of 20 bbl. an hour through 2-in. tubing with a flowing pressure of 40 pounds. At the present time, when opened to make its allowable, the well flows at the same rate and pressure.

Contract drilling	$4,820.80	3680 ft. at $1.31 a ft.
Derrick	250.00	Labor running up derrick
Surface casing	156.12	5 joints second-hand 10-in.
Cementing	240.00	Halliburton for surface and oil string.
Cement	142.50	Oil-well cement.
Casing	791.73	1005 ft. new 5 7/16-in 14-lb. 2648 ft. old 5 7/16-in. 14-lb. salvaged from Well No. 19
Trucking	89.00	Hauling casing, etc.
Cable tools	500.00	Contract.
Fittings	62.50	Miscellaneous well-head connections.
Total	$7,052.65	Drilling and completion costs.
Eastman charges	$1,206.44	Directional drilling, surveys, etc.
Total	$8,259.09	Cost to operators for flowing well.

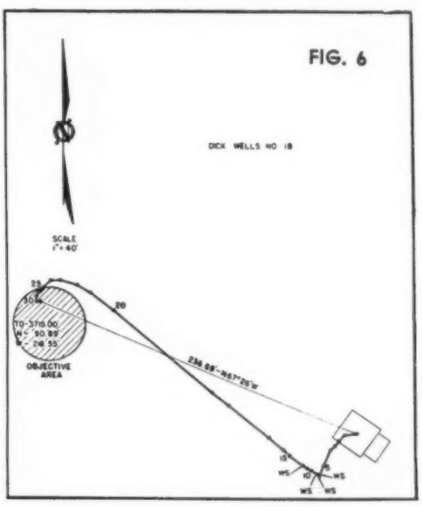
Distribution of directional-drilling time for this well affords an interesting comparison with that of the first deviated well, and is shown in Table 5.

The actual out-of-pocket cost of this well to the operators, as taken from their records, was as follows:

In this instance, as in the preceding one, the availability of salvaged material had a substantial bearing upon the total cost of the well. Though on this well two less whipstocks were set than in No. 19A, the savings were offset by the cost of a multiple-shot survey made of the old No. 4 well before it was salvaged.

By this time sufficient data had been obtained on the western limit of the area of tight pay sand, and these data, combined with the successful results

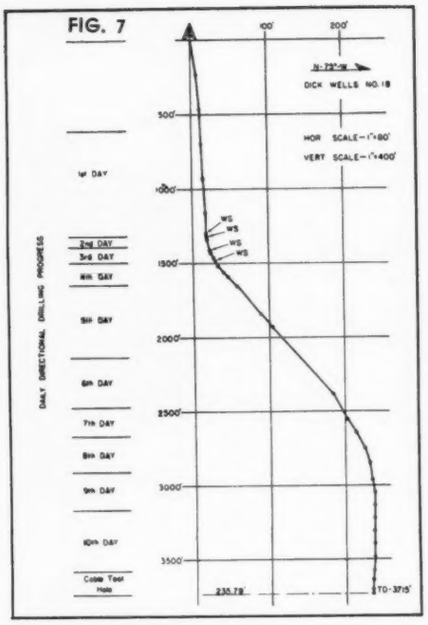
FIG. 6



obtained on these two wells, led the operators to stake out the location for well No. 18. The same rotary rig was moved on location and drilling began on March 26th and progressed in the conventional manner to a depth of 608 ft., at which depth directional supervision was begun on March 29th. Ten days later Eastman supervision was discontinued when it was evident that the hole would bottom within its objective area; the depth at this point was 3573

Contract drilling	$4,790.67	3657 ft. at $1.31 a ft.
Derrick	250.00	Contract labor running up derrick.
Surface casing	157.62	105 ft. second-hand 10-inch.
Cementing	250.00	Halliburton for surface and oil strings.
Casing	1,173.23	{ 1490 ft. new 5 7/16-in. 14-lb. casing.
Cement	142.50	{ 2155 ft. new salvaged from well No. 4.
Trucking	140.00	Hauling casing, etc.
Cable tools	500.00	Contract.
Fittings	19.60	Miscellaneous.
Total	$7,413.62	Drilling and completion costs.
Eastman charges	1,259.38	Directional drilling, surveys, etc.
Total	$8,673.00	Cost to operators for flowing well.

FIG. 7



feet. The whipstock record on this well is given in Table 6.

The results of knowledge previously gained of local conditions is reflected in the reduced number of whipstocks used to gain the desired objective, in this latter well, and in the reduction of directional-drilling time to ten days. Examination of the general data given in Table 1 also leads to some interesting comparisons. As shown in the horizontal projection, Fig. 6, the hole had started in a southerly direction when directional supervision began. The first two whipstocks set succeeded in turning the hole 100 deg. to the right and building up a drift angle of 3 deg. in approximately the desired direction. The remaining whipstocks were set to build up angle, as illustrated in Fig. 7, the vertical projection. The gradual changes made in the drift angle resulted in an absolutely symmetrical hole that should never give a moment's operating trouble. In fact, it is reliably reported that the cable-tool drillers on these wells were surprised to learn that they were not working in a vertical hole, so easy was the action of their tools.

For comparison with the preceding operations the time distribution on the directional control of this latter well is given in Table 7.

The general uniformity of the percentage values of the various time factors, as evident in the comparative chart of Fig. 8, for all three wells, indicates a consistency of operation that can be attained only through the uninterrupted execution of a properly planned procedure, plus the understanding coöperation of the drilling personnel.

Rotary drilling was continued to the contract depth of 3675 ft., after which casing was set and cable tools moved in to complete the well at a total depth of 3715 ft. after taking in a nicely saturated section of streaky oil sands. On April 9th, 14 days after drilling began, the well was turned into the tanks. This well came in slowly, making it necessary to kick off with gas the first two days on production. The condition of the well improved, however, as pressures built up and after the first two days flowed naturally at the rate of 15 bbl. an hour through 2-in. tubing at a flowing pressure of 25 pounds. This performance is not so good as that of the other two wells and is quite possibly due to the fact that the area of tight pay sand may extend farther westward at this point than had been anticipated. By most standards, however, the well is a satisfactory one and justifies the expense to the operators, which was as follows:

It is noted that the expenditure for No. 18 is considerably higher than for either of the other jobs. This is due to the fact that no salvage material was available from other wells on the lease, and new material such as casing, tubing, bradenhead, etc., had to be purchased. This fact, however, affords us a basic figure for both conditions, and to one confronted with an operation similar to No. 18, a close estimate might be based on these figures.

Acknowledgement is given to Mr. Guy Unruh, superintendent for the Wheelock and Collins Oil Company, whose splendid coöperation in the drilling of these wells made these records available, and to J. L. Collins, whose enterprise made the work possible, and to whose willing coöperation the writer is indebted for the cost data included in this report.

TABLE 7—TIME DISTRIBUTION—NO. 18 DICK WELLS

Date	A	B	C	D	E	F	G	H
3-29	12	1½	6	.....	2	2½	.....	.....
30	3½	6½	9	4	1	.....	.....	.....
31	8	3¼	6½	¾	2½	.....	3	.....
4- 1	9½	5	7¾	¼	2	.....	.....	.....
2	20	1½	.....	.....	2½	.....	.....	.....
3	18	2	.....	.....	2½	.....	1½	.....
4	13	4	.....	.....	5	½	1½	.....
5	21½	1	.....	.....	1½	.....	.....	.....
6	18½	2	.....	.....	1½	1	1	.....
7	10	3½	.....	.....	2½	5	3	.....
TOTAL	134	30¼	28¾	5	23	9	10	
PERCENT	55.8%	12.6%	11.9%	2.1%	9.6%	3.7%	4.2%	0%

A—Drilling time. B—Trip time. C—Whipstocking time. D—Reaming time. E—Surveying time. F—Shut-down time. G—Circulating time. H—Follow-up run time.

Contract drilling	$ 4,814.25	3675 ft. at $1.31 a ft.
Derrick	625.24	New 98-ft. steel derrick.
Derrick erection	250.00	Contract labor.
Surface casing	157.00	
Cementing	240.00	Halliburton for surface and oil strings.
Cement	137.50	
Casing	2,707.86	3650 ft. new 5-$\frac{3}{16}$-in. 14-lb.
Trucking	191.00	Hauling casing, digging pits, etc.
Cable tools	575.00	Contract.
Tubing	1,079.50	3675 ft. new 2⅞-in. 4.7-lb.
Guide shoe, etc.	54.63	Float collar included.
Bradenhead	19.60	
Casing head	73.03	
Other fittings	63.75	
Total	$10,987.96	Drilling and completion costs.
Eastman charges	799.50	Directional drilling, surveys, etc.
Total	$11,787.46	Cost to operators for a flowing well.

TABLE 8—SUMMARY OF RESULTS

Well Number	Deflection Feet	Total Days	Total Cost	Flowing Rate	Flowing Pressure
19A	183	19	$ 8,259.09	35 bbl.	50 lb.
4A	211	20	8,673.00	20 bbl.	40 lb.
18	237	14	11,787.46	15 bbl.	25 lb.

TABLE 6—WHIPSTOCK RECORD WELL NO. 18

WS	Depth	Single Shot	Expected Results	Actual Results	Setting
1	1303 ft.	2° 50′ S25°W	3° 35′ S70°W	1° 50′ S70°W	N50°W
2	1323 ft.	1° 50′ S70°W	3° 35′ N67°W	3° 00′ N57°W	N60°W
3	1412 ft.	2° 30′ N57°W	5° 00′ N57°W	4° 30′ N60°W	N57°W
4	1502 ft.	5° 15′ N58°W	7° 45′ N58°W	7° 30′ N56°W	N58°W

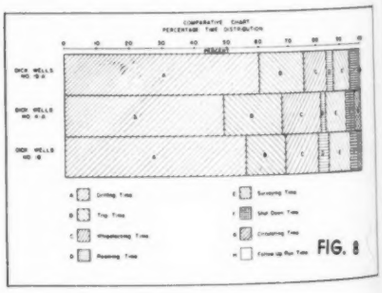


FIG. 8

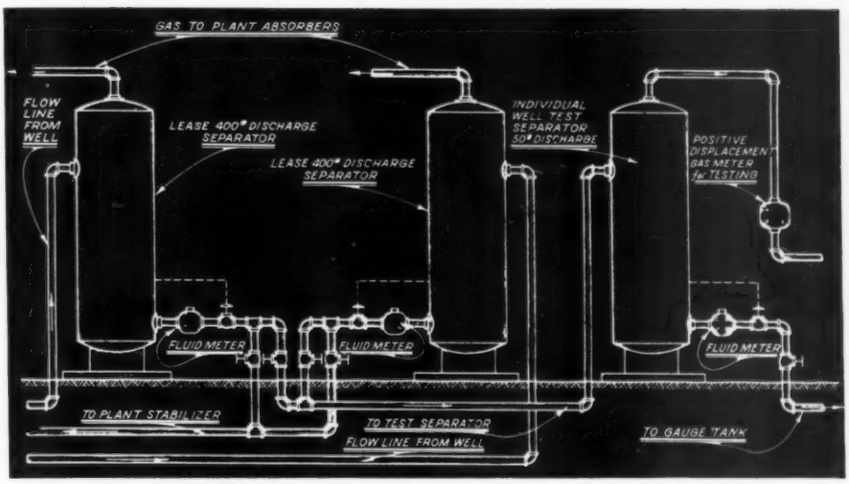


Fig. 1. Schematic diagram showing method employed to test oil meters

By

E. O. BENNETT

and

C. R. WILLIAMS

Combined Crude Stabilization, Natural Gasoline, and Pressure Maintenance Operations » » »

Because of the far-reaching importance of the subject discussed, the accompanying paper, presented before the annual convention of the American Gasoline Association of America, is given here in abstracted form. The Tepetate plant discussed, representing as it does a modern pioneer project, was covered in detail in the September, 1936, issue of The Petroleum Engineer.

FIELD stabilization of high-gravity crudes has proved to be an important step in the petroleum and natural gasoline industry, as well as a very definite move in conserving products that previously have been lost by evaporation. Continental Oil Company is fortunate in owning a complete structure, developed in an orderly and "planned-in-advance" manner, where such operations are now in effect.

Stabilization may be defined as controlled evaporation in which all desirable fractions are caught and saved instead of being allowed to waste to atmosphere. By stabilizing in the field up to 50 percent of the products normally lost by evaporation may be recovered as saleable products.

The initial formation pressure at Tepetate was 3650 lb. per sq. inch. Oil produced from a formation with this pressure has much gas in solution and must be kept under pressure until it is stabilized to prevent losses.

Raw Crude Metering

Oil is produced through small chokes ranging from 3/32-in. up to ¼-in. diameter. Lines carrying both gas and oil are taken directly from the wells to the lease separator battery, which is at a central point inside the stabilization and gasoline plant yard. A separator and meter are provided for each lease. After the oil is metered it is taken in a common stream to the main stabilizer. Gas from the lease separators is metered separately and then flows in a common system to the absorber.

All separators are so connected that any meter in the battery may be tested without withdrawing it from service. As shown in the schematic diagram in Fig. 1, when desired, an individual oil meter can be tested by diverting a metered oil stream to the test separator, which is equipped with calibrated test meters.

Any desired volume may be passed through the test separator and meter to compare with the lease meter. While running oil through the test separator, any gas that may leave the fluid is metered and the liquid volume corrected for the liquid equivalent of the gas.

After metering crude oil from the various 500-lb. pressure lease separators situated inside the plant yard, it is collected in a composite crude header and passed through exchangers where it is heated by crude leaving the stabilizer.

After the exchange, raw crude is passed to a 25-lb. flash tank at about 125 deg. fahrenheit. Gas from this separation goes directly to the gas reabsorber where the gasoline it contains is removed and included in the natural gasoline from the main absorption process. Crude oil from this separation passes through additional exchangers and then through the reboiler into the crude stabilizer.

The crude stabilizer is operated at 55-lb. pressure with the conventional cold-liquid reflux. In stabilizing, operations are conducted to remove all undesirable constituents such as propane and lighter. Crude is not denuded of gasoline beyond that normally lost in natural weathering from lease gauge tanks.

The following low-temperature fractional analysis will show the type of crude handled and the stabilized crude produced:

Component in volume percent	Raw crude from 500-lb. separator	Stabilized crude
Methane	3.63	None
Ethane	2.09	None
Propane	2.89	None
Butanes	2.30	2.03
Pentanes	3.62	4.30
Hexanes	7.04	7.28
Heptanes and heavier	80.73	86.39
	100.00	100.00

In the Tepetate combination absorp-

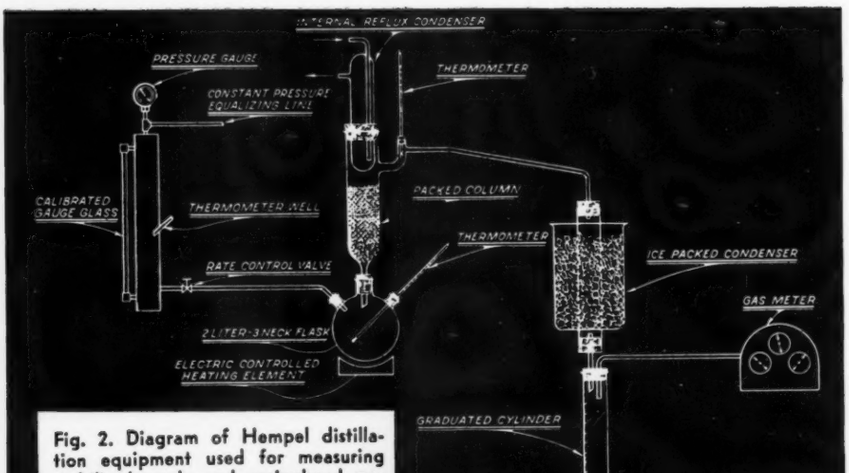


Fig. 2. Diagram of Hempel distillation equipment used for measuring stabilized crude and casinghead gas

tion and stabilization plant gas from the 500-lb. lease separators is metered, after which it passes through a common header to the high-pressure absorption plant for the extraction of its natural gasoline content.

Gas to the high pressure absorber has the following analysis:

Component	Mol. Percent
Methane	88.97
Ethane	6.50
Propane	2.61
Butane	1.38
Pentane	0.34
Hexanes & heavier	0.20
	100.00

The gas leaving the high-pressure absorbers has the following analysis:

Component	Mol. Percent
Methane	93.30
Ethane	3.84
Propane	2.21
Butane	0.65
Pentane	None
	100.00

A portion of this high-pressure residue is used for field operations and sales; the remainder is compressed to about 3600 lb. for pressure-maintenance operations in field production.

Salt Deposition

Shortly after beginning operations, salt deposition in the heat exchangers and preheaters caused considerable trouble. This difficulty was overcome by introducing fresh water prior to the crude's passage through the exchangers. Only a very small quantity was used to prevent salt deposition, and the overall B. S. and W. content of the crude was not altered as the water added was just sufficient to equal that flashed out of the crude.

The Laboratory

Prior to building the plant, laboratory analyses were required for the determination of losses and recoverable portions of those losses before the economics of stabilization could be calculated. The laboratory also was called upon to provide the component analyses of all raw materials for process and design calculations.

With the installation of high-pressure liquid meters to measure the raw crude for royalty settlement, came the laboratory's most complex problem. Since crudes ranging in gravities from 34 to 59 deg. A.P.I were being measured and combined, it became necessary to determine the quantities of stabilized crude, recoverable gasoline, and non-condensable waste that oil from each lease would sustain in the subsequent processing, so that the quantity of raw crude as metered from the high-pressure lease separator could be corrected to give the quantities of stabilized crude and recoverable gasoline. After considerable research the modified Hempel test, as shown in Fig. 2, was adopted as the simplest and most reliable method of making these determinations.

Hempel analyses determine the percentage of stabilized crude, recoverable gasoline, and non-condensable gas that will result from processing the oil from each lease. These percentages are applied to the quantities of raw crude metered to determine the theoretical bbl. of stabilized crude and recovered gasoline that the lease should produce. These quantities are determined for all leases and the total is divided by the actual plant production to obtain a plant equalizing factor. The resulting equalizing factor is then used to correct the theoretical lease yield to actual plant yield per lease. Experience, however, has shown that theoretical yields from laboratory determinations have deviated very little from the actual plant yields.

When meters were being tested to determine whether they could be used under the high-pressure field conditions, a meter setting on a high-pressure trap was made and the oil, after being measured, was flashed into a calibrated gauge tank, where it could be accurately gauged and the flashed gas metered.

Calculating the gas to its liquid volume and adding this quantity to the oil received in the gauge tanks invariably gave a greater quantity of oil than had been measured by the high-pressure lease meter. This condition was contrary to the type of error expected from "gassing" in the meter.

The laboratory then set up equipment, as shown in Fig. 3, to determine the solution volume of the flashed gas. After these data were available, the sum of the gauged oil and liquid solution volumes of the flashed gas gave almost identical checks with the high-pressure meter, thus proving that metering raw crude under high pressures was practical.

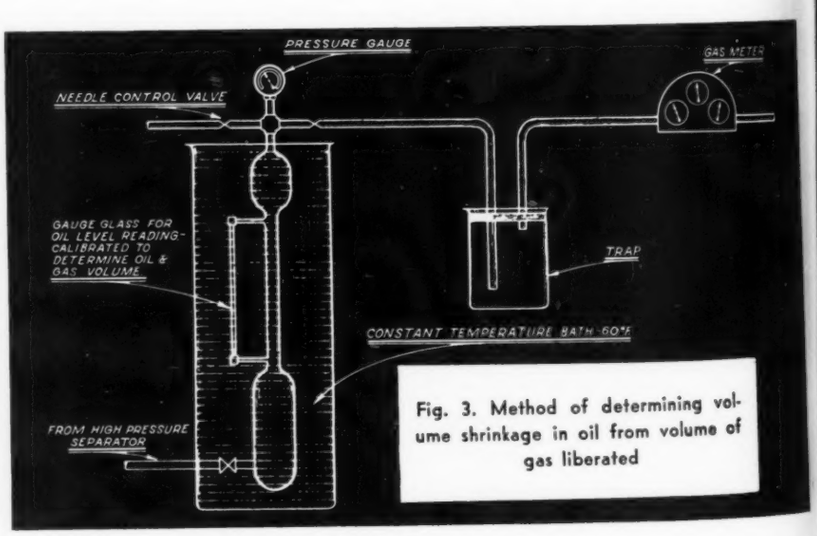

PRESSURE GAUGE
GAS METER
NEEDLE CONTROL VALVE
GAUGE GLASS FOR OIL LEVEL READING-CALIBRATED TO DETERMINE OIL & GAS VOLUME
TRAP
CONSTANT TEMPERATURE BATH 60°F
FROM HIGH PRESSURE SEPARATOR

Fig. 3. Method of determining volume shrinkage in oil from volume of gas liberated

The plant is now operated under complete laboratory control. The laboratory is equipped for making low-temperature fractional analyses as well as Hempel tests, in addition to the regular gasoline plant control tests.

Tepetate Pressure Maintenance Plant

The Tepetate absorber and stabilization units were designed for operation in conjunction with a pressure maintenance system to provide residue gas up to 500-lb. pressure. At the present time gas is delivered to the compressors at approximately 350 pounds. This pressure will be raised as soon as additional input wells are completed, thus permitting the handling of more gas.

The compressor plant is unique in several respects and contains every known means of assuring maximum safety in operation.

The compressors used are of the new type with vertical power cylinders and horizontal compressor cylinders. They are 300-hp. units operating at 300 revolutions per minute. The low-pressure cylinders are of 4¾-in. diameter. The high-pressure cylinders are 3 in. in diameter and are of the single-acting plunger type. Each unit has one low-pressure and two high-pressure cylinders. The high-pressure cylinders are outside packed with metallic rings riding directly on the plungers.

Safety Features

A liquid carry-over, safety-cutout, Fig. 4, is used on the low-pressure intake. It consists of a vertical receiver with an outside float. Instead of operating a liquid discharge valve, the float operates a mercoid switch that short-circuits all engine magnetos, thus stopping the plant before any liquid that might accidentally carry over from the gasoline plant could reach the compressor cylinders to cause breakage. This same mercoid switch is connected so that it can be operated from several points outside the plant for complete shutdown in event of an emergency.

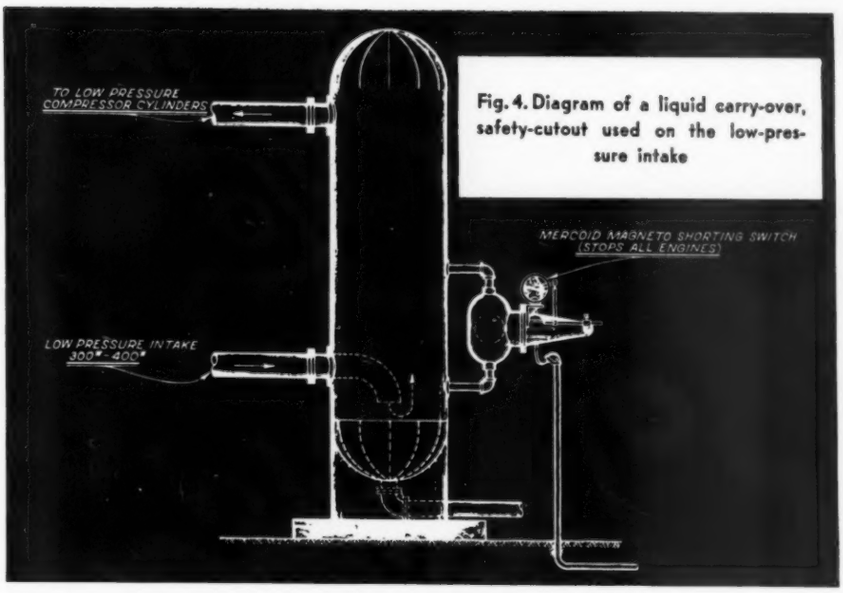


Fig. 4. Diagram of a liquid carry-over, safety-cutout used on the low-pressure intake

Intercooling is obtained through several banks of welded pipe sections wetted by inverted water sprays with well water at 65 deg. fahrenheit.

The two high-pressures intakes are tied together at the cylinder blocks; the discharge lines also are connected at the cylinders. This eliminates two plug valves and two check valves.

Check Valves

A check valve is installed in each discharge line between the compressors and the headers. This is to prevent gas from flowing into the plant in event of a line break near the cylinders. Checks also are installed at the end of the header where field lines are taken off.

The headers at the pressure plant all are above the normal grade to prevent their corrosion and the possibility of failure from that cause. With the floor elevated above grade, no pockets for retaining gas can exist. All headers are supported on concrete piers and are anchored by collars with adjustable anchor screws to allow for creeping occasioned by temperature change. After all headers reach normal operating temperature, the anchor screws are turned down to contact the pipes and all vibration is damped out. The installation of the header anchors is shown in Fig. 5.

All connections at the plant are welded, with the exception of the flange connections at the compressor cylinders and valves. Flanges with soft-iron ring gaskets in grooves are the only type used. They easily are made absolutely tight. All operating valves in the gas system are of the lubricated-plug type and have been found most satisfactory for this service.

All connections to headers have been reinforced with gusset plates to eliminate the possibility of breakage from temperature stresses. The discharge temperature from the compressors is approximately 275 deg. fahrenheit.

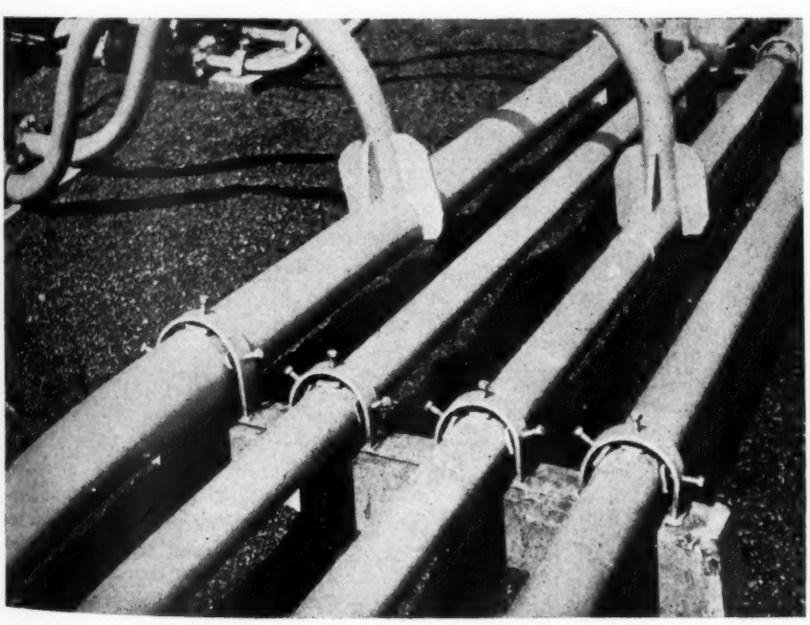


Fig. 5. All headers are supported on concrete piers and anchored by collars with adjustable anchor screws

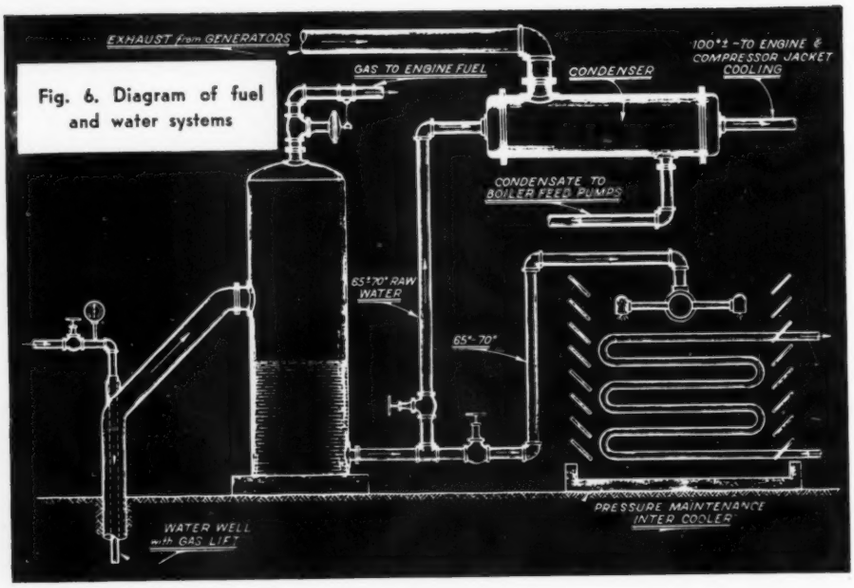


Fig. 6. Diagram of fuel and water systems

Circulating Water

A 350-ft. gas-lift water well was designed and put into service. It is capable of producing 105,000 bbl. daily. The water and gas from the well are carried into a 7-ft. by 22-ft. separator. The gas is then used for engine fuel, the pressure being reduced by lifting the water instead of by the customary pressure-reducing valve. (See Fig. 6.)

Water controlled by a float valve is passed through two condensers where it condenses steam from a 300-kw. and a 200-kw. turbo alternator. The alternators supply electrical energy for the stabilization and absorber plant. In condensing the steam, temperature is raised from 65 to 100 deg., which is desirable for engine jackets. Part of the cold stream is taken to the sprays for gas intercooling and lubricating oil coolers. The condensate from the turbines is returned to the boiler feed pumps at a temperature of 212 deg. and eliminates approximately 85 percent of the raw water make-up and treatment formerly required. All boiler priming has been eliminated.

This type of cooling system is simple, requires no pumping machinery, and where ample water is available it is most economical to use. Temperatures are controlled by flow rates in various parts of the system.

Each engine is equipped with a low-pressure mercoid cutout on both water and lubricating oil circuits. The failure of either will shut down the engine and prevent damage. Vapor-proof magnetos are used in the engine ignition system.

The engines are placed back-to-back with compressors towards the outside walls, which arrangement makes a very compact layout. The only lines in the center of the building are air-starting, fuel, and water. Exhaust lines are overhead, and mufflers are above the roof. This design gives the least back-pressure on the engine exhaust. By insulating the jacket around the exhaust lines, a very cool operating temperature in the engine room is maintained.

Field Lines

Field lines to input wells are anchored heavily at both the header and well ends. To provide for expansion resulting from extreme temperature changes from idle working conditions, expansion loops in vertical planes are installed. These loops are approximately 9 ft. in diameter and have 36-in. openings at the bottom. They are anchored laterally by stay-rods and deadmen.

Freezing and Formation of Hydrates

When gas was first injected for test purposes into a well at Tepetate considerable difficulty was experienced with freezing at the well-head connection. Gas left the compressor at 275 deg. fahr., and the line froze solid after about ten hours operation because of the formation of hydrates, crystalline compounds made up of water vapor and hydrocarbon gases.

Some very comprehensive work on the formation of hydrates in connection with natural gas transmission lines has been done by E. G. Hammerschmidt (Ind. & Engr. Chem. Aug. 1934) on pressures up to 800 lb. per sq. inch. The empirical formula,

$$T\ ^{o}F = 8.9\ (P_{abs})^{0.285}$$

developed by Hammerschmidt was extended up to 4000-lb. pressure, and the temperature at which hydrates formed was found to be close to the temperature existing in actual practice. The fact that the composition of the gas and amount of water vapor present differed from that in the work of Hammerschmidt had a definite effect upon results obtained. The above formula, however, is considered accurate for practical purposes with ordinary residue gases used in repressuring and pressure-maintenance work.

To continue operations, it was necessary to dehydrate the gas completely or insulate the line sufficiently to keep the temperature above the critical point for the formation of hydrates until the gas reached a depth in the well where subsurface temperatures were high enough to maintain gaseous conditions.

Dehydration of large volumes of gas is very expensive. Consequently the freezing was overcome by insulating the line from the compressor to the well and works very satisfactorily. Upon completing a large plant and using a larger line, it was found that sufficient heat was carried by the gas to prevent the temperature dropping to the critical value, without the necessity of insulation. No expansion of the gas is necessary for the formation of the hydrates as it takes place with temperature reductions by radiation.

Hydrates appear in the form of snow and gradually build up inside turns, in valves, or at any irregularities in the system, packing in the form of opaque ice. The formation appears more rapidly under high pressures for a given volume of gas, due to increased density and lower velocity of flow.

Working Pressures and Flow Formulae

Normal working pressures at the Tepetate installation are from 3500 to 3750 lb. per sq. inch. This is believed to be the highest working pressure ever used in returning gas to producing formations for oil recovery purposes. Under this condition a cu. ft. of gas weighs approximately 16 lb., or about one-fourth that of water, and velocities are low. When handling 7,000,000 cu. ft. a day at 3500 lb. per sq. in., a line with an inside diameter of 3.246 in., the velocity is about 6.5 ft. per second.

In attempting to design lines for carrying gas from the pressure plant to input wells, it was found that the gas flow formulae ordinarily used were not accurate for pressures in excess of 3000 lb. per sq. inch. Liquid flow formulae with correction factors for flowing density appear to give results in keeping with actual practice. Data are being obtained in an attempt to develop empirical formulæ that can be used for extreme-pressure line design.

Economics of Executive Control

By CAMPBELL OSBORN

Studies that will reveal opportunities for improved financial management and reduced operating costs

THE strength of an oil company's position depends upon more than mere volume of output and the price of petroleum. So far as production and holdings are concerned we all have seen companies rise in a comparatively short span of years from almost nothing to a major position in the industry; but in many instances most of the money for expansion came from outside the industry and the record of net earnings and dividends of such companies has been dismal.

This condition could not justly have been charged to oil prices for they were high most of the time. It must have been due to the lack of proper balance between the various divisions of the companies' operations, or to failure to analyze, scrutinize, and keep costs down, or to inability of the management to fit itself into the general economic position of the industry, or to other unsound policies of finance and overall executive control. In some instances it may have been due to all these things in some degree.

Many companies individually, and the industry as a whole, have taken long strides forward in management in the last decade. Engineering and economic studies are no longer confined to measurements of demand, supply, and price. Intensive studies based on accounting records and the statistics of the industry and useful to management are being made of operations and costs. Measures are being made of the efficiency of operations and the causes of loss, determined for the purpose of removal. All opportunities for improvement by no means have been exhausted, however.

Overproduction or shortage, use of research work, producing, inventory, and cash position, the dependence of each branch of the industry upon others, and the relation between the operations of the various major departments of the same company all are worthy of careful study by management. Efficiency and economy are relative terms. In some companies a high degree of efficiency exists in all operations, but there are always places where improvements can be made. In others inefficiency prevails in all departments. Some companies may be fairly economical and effective in one branch of their work, but very wasteful in others, and while their operations finally result in some net profit, there are good reasons why they could be larger.

No Company Is Self-Sufficient

Time was when all a petroleum executive asked was to be let alone, especially by the government. He did not know nor care what was the national demand for oil. If he was a large refiner and marketer he wanted crude oil and he got it, and he saw to it that there was a good spread between the cost of his raw material and the price of refined oils.

Today, while the strongest companies might maintain a comfortable margin between their costs and the price of products regardless of demand, their chief executives are keenly interested in national conditions and are alert to what other oil corporations are doing.

It is now generally recognized that prices are controlled by demand and supply, temporarily modified by planned economy and slightly influenced by costs. Management recognizes the facts and conducts the oil business in accord with its best appraisal of these factors. No oil company except the extremely lucky ones can hope to make money nowadays without fitting itself into the general economic picture. My personal views of these important factors and methods of studying them have been previously discussed in *The Petroleum Engineer* and will not be repeated here.

The writer believes it is generally recognized also by oil men that they are less sufficient individually than ever before in the history of the petroleum industry. Even the biggest companies still depend upon the smaller ones for raw material. While the large companies probably produce more of their crude oil requirements now than heretofore, much of their runs to stills are made up of oils produced by thousands of small operators served by the pipe line and crude oil marketing affiliates of the major units; and as the large company is dependent in part upon the small one for crude oil, so the little company must rely upon its big brother for a pipe line and market outlet. Bold indeed is the wildcatter and small producer today who risks his money in search of production unless he has a more or less assured market for his production.

While the pipe line company is dependent upon the producer for something to run, pipe lines seldom have been built without an assured oil supply and that is why this branch of the oil business has been the most uniformly profitable. The crude oil marketing companies, of course, have no investment except in crude oil and tanks, but woe unto them if they unwisely tank oil at too high prices or lack refining connections to take their purchases. Woe unto the refiner, also, who has no assured crude oil supply that he can buy if his own fails, and a well-cemented outlet for his output if he has no controlled market of his own.

Thus it will be seen that, with the exception of the integrated companies engaged in all major branches, each company is dependent upon others to complete its operations. The managements of the non-integrated companies therefore must consider carefully their dependence upon other units of the industry and if they expect permanently to prosper their relationship with others who can supply what they lack must be firmly cemented.

The producer of crude oil is dependent upon the pipe line and the crude oil marketer or the refiner for his market outlet. In new areas the producer long has been accustomed to finding the local market flooded with oil. He often is faced with flush production, danger of drainage by neighbors, inadequate transportation facilities, refusal to buy on the part of the local crude oil marketers, and declining prices. In some cases he may store his own oil, but often he cannot escape loss. Obviously the control of either

refinery or transportation facilities, or both, leading to such a plant would be a valuable asset. In the absence of these controlled markets he should firmly build up his relations with dependable outlets so that they will not fail him in time of need.

Though the pipe line is necessary to the inland producer, the former is equally dependent upon the latter. The producer may drill wells in various districts, but pipe lines cannot be moved except at great expense, and in order to yield good profits they must be operated constantly at or near their maximum capacity. Trunk lines ordinarily are constructed so that they can tap numerous fields and, as some decline, others can be reached with short gathering systems as they are discovered. The pipe line and affiliated companies are large crude oil purchasers and sellers, and a refiner, like a source of crude oil to run, is vitally important to them. The well-managed pipe line and crude oil marketing company attempts permanently to solve both of these problems before facilities are constructed.

During the last 20 years perhaps no phase of economic balance or interdependence of the various divisions of the oil business has been more forcefully illustrated by experience than the dependence of the refinery upon an adequately-controlled crude oil supply and a guaranteed market outlet. Aside from obsolete equipment and injudicious location, the causes for practically all the idle plants and intermittently- or partially-operated stills may be traced to these influences. Many refineries have found it necessary to engage in producing and marketing activities, while others have solved the former problem by the ownership of pipe line systems. The last two decades have taught many an oil man a bitter lesson in these directions that he will not forget.

Importance of Balanced Operations

Let us descend now from the conditions an oil executive cannot individually control—but which may make or break him—to the internal workings of his company that are under his thumb. If a company is engaged in only one branch of the oil business—and vulnerable it is to be in that position—what is said here has no application to it, but if it is engaged in more than one, the application is vital.

The strongest company in the petroleum industry is the integrated corporation with a controlled, refined oil market outlet in excess of its refinery capacity, refining capacity in excess of its produced crude oil supply, and a controlled, by ownership or affiliation, crude oil buying corporation and pipe line system. Such a company's position comparatively is impregnable, but relatively few companies occupy that position. Some are primarily crude oil producers with a small gathering system and refinery and little or no market outlet. In times of overproduction they may be left high and dry by the marketers and be forced to sell their output at extremely low prices. Companies, large or small, in the weak position described would be strengthened by following the policies of the large integrated units.

In other companies the crude oil supply phase of their business has been neglected and most of their attention has been given to refining and marketing or both. That was once the position of the Atlantic Refining Company and the Standard Oil Company of Indiana, so far as production by themselves was concerned. It has been corrected in both instances. This is not so serious an error as neglect of a market outlet, but it is a violation of sound balance in oil integration.

In some integrated and partly integrated companies there has been friction between the department heads. At times some branches of the business have been more profitable than others, and the chief executive expected the efficient departments to absorb the losses of the others. It seems that the best management would require profit from each division. Enough companies and individuals are engaged mainly in each branch of the oil business to assure keen competition and a sound economic foundation to every step whereby oil moves from the well to the consumer, and there is no good reason why each division of an oil company should not make some money most of the time.

Producing, Inventory, and Cash Position

Plainly, if an oil corporation brings petroleum to the surface or refines it in quantities exceeding that which it can sell the result may be a dangerous strain on the company's cash position. Overproduction for the industry and ruin for many companies often have been caused by failure properly to balance these factors.

There is a natural desire on the part of an oil man to grow. Inefficient operators thus are driven out of business. That is competition. But are all that survive efficient? The overproduction and burdensome stocks from which the industry has long suffered may be ascribed to output in excess of profitable market outlet and failure of management properly to weigh costs and prices and balance production and markets under the rapidly changing conditions that characterize the oil business. These are the main factors responsible for the unhappy situation that still harasses many oil companies in the present period of recovery.

In profitable times there is a tendency on the part of some executives to get careless about their cash and inventory positions. While credit is easily obtained then, it may be difficult or impossible to procure when conditions are reversed. Though there is no general rule or practice that will solve this problem, it would seem that careful executives would maintain a cash position that would pay necessary operating expenses over an extended period of low prices.

Inventories largely in excess of needs to meet seasonal requirements and the steady growth of business are worse than idle capital. They entail carrying charges, they evaporate, and with the drastic price changes to which oil is subject, the ownership of top-heavy stocks quickly may destroy a sound current asset to liability ratio. In good times oil men are prone to view inventories as the equivalent of cash, but even though they be set up at the lower of cost or market value, they are not cash. Costs may be high and values inflated and there are few things at which a financial man will scowl more than at a weak cash position in the face of excessive inventories. We have all seen companies forced to liquidate large inventories at less than half the values set up in balance sheets that were in no sense old.

It is unnecessary to remind oil men that overproduction and excessive inventories long have been the outstanding weakness of the petroleum industry, but they have been doing something about it during the last decade. Careful studies have been made of their own positions and of the position of competitors. It is to be hoped that the risks taken in the past will not be repeated and the oil companies drained financially as they were during the seven lean years that followed 1929. Output and inventories are in sounder relation at this time than they have been in many years, and there seems to be a strong desire among oil men to keep them that way.

Sound business tests should be applied constantly to inventories. So far as possible they should be kept relatively active. When used as assurance

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of adequate supply to meet requirements in excess of current production, or to meet fluctuations in seasonal demand, they are healthy and have a tendency to stabilize the oil business, but beyond this their effect may be the opposite.

Good Research Work Aids Management

Research work upon the economic, engineering, and scientific problems of the petroleum industry is playing an important role in its development. Recognition of the value of this work and of its practical aid to the oil man has been slow, but it is attracting more attention and support as it demonstrates its merits. Research is entitled to some of the credit for the progress of the oil business and the prospects for further improvement that may be traced to it are good. The well-managed companies of course are taking full advantage of practical research.

The Control of Operations

Until late years management has looked largely to its accounting departments to find the reasons for losses in some departments and the lack of expected profits in others. With the growing complexity of the industry, old accounting methods have been improved and in some companies, with the aid of economics and engineering, management now has the benefit of monthly reviews of output, costs, sales, inventories, prices, and profits or losses in logical relationships. The information is so prepared that studies can be made over a period of time and the experience of competitors compared. The value of work of this sort of course lies in the ability of the engineer or economist to assemble related information and the judgment the management can marshal in analyzing it and arriving at proper decisions. These studies are especially useful in reducing costs. In his memoirs the late John D. Rockefeller has stated that his first experience was as a bookkeeper. Aside from his deep interest in organization, no subject commanded more of his attention than expense, and it is said that he showed his greatest enthusiasm when his associates announced reductions in costs.

Finding the Leaks in Production

There is a wide variation in the lifting expense of different oil companies in the same fields. Equally at variance also are the land and drilling costs of the producing companies in identical pools. No subject is worthy of more attention than the costs of crude oil production.

Some companies prepare estimates of investments required for acquisition and development and of probable profits in advance of leasing. No one knows whether a test well will be productive, and it is impossible to estimate the ultimate yield of a productive lease until sufficient wells have been put down to ascertain the sand conditions. The best operators, however, know from experience about what the ratio is between the wildcats they drill and the new fields they discover. Where drilling has been done by others depths and the cost of completed wells readily may be estimated; and under modern petroleum engineering practice an oil company may procure a reliable estimate of ultimate yield much earlier in the development of a field than in past years. Competition, of course, controls lease bonuses and rentals, but that is the first outlay, and if land prices are too high in a specific area investments there may be avoided. Other expenses may be calculated in advance and are subject to control. Cost study and control should not end with the conclusion that a profit can be made and the subsequent completion of the wells. Regardless of their state of development or age, leases should be scrutinized closely from time to time to determine the cost and profit or loss per barrel. Proper study may reveal that costs for specific wells are hopelessly greater than existing or expected prices, while others can be made profitable only by radical improvements in lifting methods. The cost items that make up the total lifting expense should be segregated and plotted to ascertain the trend and whether the more expensive outlays can be reduced. Details of this work are too numerous for discussion here.

Reducing Refining Costs

A properly located, efficiently operated plant should be able to buy crude oil at the market price, manufacture refined products, and profitably sell them at current wholesale prices over a period of years. Some refineries have been constructed with the thought that they would solve a crude oil marketing problem, and they have been located and operated from this viewpoint. When it appeared that they were unprofitable an effort was made to correct the weakness with a controlled retail market outlet, and each step in the operations of the company was considered a service to the following branch. Finally the sales department was expected to make the company its money. The thought that some of the major departments of an oil company should serve others is sound, but, as shown in the cases where the sales branch failed to make the expected ultimate profits, this idea of service can be carried too far. In the long run efficient refining by itself is profitable at bulk refined oil prices.

Profits per bbl. are small in refining and it is a job that calls for great skill. The cost of crude petroleum is the largest item of expense. As is well known to refiners, other items are fuel, labor, blending materials, depreciation, overhead, and miscellaneous materials and expenses. When detailed costs are assembled and compared to output and prices they present a striking picture of cost movements and profits or losses that result from variations in operations.

In the older companies most of the weaknesses have been found and remedied, but in some of the newer ones the explanation for high costs has not been found.

Variations in runs to stills caused the greatest losses. Sometimes the plants were operated at one-half capacity for extended periods. The personnel was demoralized and the cost per gal. of output was increased to a figure that resulted in large losses. In one case the gasoline costs were increased 50 percent. It could not be charged to raw material expense because there was little change during the period studied. Investigation showed that the labor costs per unit of output were nearly doubled; that depreciation and overhead expenses were not materially reduced by the curtailment; that the fuel expense per unit of output was increased from 25 to 50 percent; and finally that the other miscellaneous costs per gal. of finished products were very substantially higher. Over-extended experimental work in some departments also caused large losses. Weaknesses of the sort described, coupled with unsound sales and financial policies, despite good equipment, low competitive fuel expense, and a cheap, controlled crude supply, caused one large Mid-Continent plant with which the writer is familiar to lose more than a million dollars during the first five-year period of its life on an investment varying from five to ten million dollars.

Cleaning Oil Sands with Hot Air

Efficiency of the Method Improved by Thoroughly Insulating Hot-air Tubing

By F. R. COZZENS

CLEANING oil sands with hot air is a practice that is giving good results in the shallow sand fields of southern Ohio. This is one of the oldest developed oil and gas territories in the country, operations having been started in a crude way some years prior to the Civil War. In 1910, air under pressure was first introduced to replace natural gas for pushing oil through the sands, and as is usually the case where air is applied continuously over long periods of time, sand channels gradually had become clogged with paraffin until the wells became strippers. At this stage, various rejuvenation methods were tried, such as burning off the sand face with light charges of nitro-glycerin, steaming the sand, and introducing artificial circulation by means of water. These proved to be temporary remedies, and it was generally agreed that the only practical solution was melting out the residue by some medium that could be introduced directly into the sand. Such a process became a reality, with the adoption within the past five years of the effective use of insulation. Using tubing insulated for the purpose, the modern operator applies heat to oil-sands 2000 ft. underground; and with the same efficiency that temperature is controlled at the surface.

When a well reaches the stripper stage, and before natural rock pressure is entirely gone, the shallow-sand operator removes the pumping equipment from the well. He then obtains a rubber casing packer a fraction of an inch smaller than the inside diameter of the casing. The packer is anchored to a 20-ft. section of 2-in. insulated tubing and run into the hole. Additional sections of insulated tubing are attached until the packer reaches the desired position at the bottom of the casing—usually a few feet above the oil sand. After the packer is set, from three to six ft. of loose earth, sawdust, or asbestos fibre are then dumped down the hole to pack the annular space around the tubing and thus prevent excessive heat from injuring the casing.

The upper end of the 2-in. insulated tubing is then connected at the surface with a gas-engine-driven compressor. Compressed air, heated in the cylinder to a temperature of 300 deg. fahr. is injected down the well. Injection is continued for 70 or more hours, or until the air pressure at the casing head reaches 600 to 1000 lb. per sq. inch. The compressor is then stopped and the air pressure released through a valve in the tubing head.

This initial application of air seldom gives permanent results, but it does cause to flow into the well, sludge, mud, and molten paraffin, which are later removed by suction bailer. After this emergency cleaning is completed, the insulated pipe is again run, and a second, and maybe a third, application of air is applied in exactly the same manner. By this time, a marked improvement in natural rock pressure may be observed, because the sand channels surrounding the well for a considerable distance are free of residue. In more than 80 percent of the cases, production is increased 30 to 50 percent. The period of increased production depends of course upon the texture of the sand, etc., but months and even years usually elapse before the well needs another treatment of hot air.

On the average lease, this method of sand-cleaning is held down to a cost of $25 to $35 per well, owing to the fact that insulated pipe may be used again and again, and under ordinary conditions will last for years. In cases where two or more wells must be air-treated at the same time from a compressor centrally situated, costs are somewhat higher because air-cell asbestos packing, or 85 percent magnesia wrapper must be used on all outside lines to conserve heat. In all cases, cleaning the productive sand in a well by this method can be carried out by the ordinary crew of workers.

A greater volume of production, better grade of oil, and prolonged life of the well, are some of the beneficial results of hot-air sand cleaning. The method is easily adapted to any type of sand, and can be utilized at any depth, provided insulation is applied to conserve heat.

Interest in Permian Basin Causes Reprinting of Engineering Report

ACCUMULATION of oil in natural limestone reservoirs in West Texas and southeastern New Mexico continues to attract the attention of a large and interested group in the petroleum industry, observes the United States Bureau of Mines, Department of the Interior.

In November, 1936, the Bureau of Mines published an engineering report on eight typical fields ranking among the highest in total production in the Permian Basin. This Basin comprises the area south of the Panhandle and west of the Bend Arch or Central Basin region and contains approximately 70 oil fields with 4200 producing oil wells. The report gives the results of a detailed study of the Big Spring field, Texas, and contains pertinent data on Yates, Hendrick, Church-Fields-McElroy, Big Lake, Penn, and Westbrook in Texas, and Hobbs in southeastern New Mexico.

The first edition of Bureau of Mines Report of Investigations 3316, Petroleum Engineering Study of the Big Spring Field and Other Fields in West Texas and Southeastern New Mexico, by Charles B. Carpenter and H. B. Hill, published in cooperation with the Midland, Texas, Chamber of Commerce was soon exhausted. Requests for this report containing 223 pages of text and 40 illustrations have continued in such numbers that the Midland Chamber of Commerce again has given cooperative assistance, and a limited second edition has been published. Single copies are available from the Chamber of Commerce, Midland, Texas, price $1.00.

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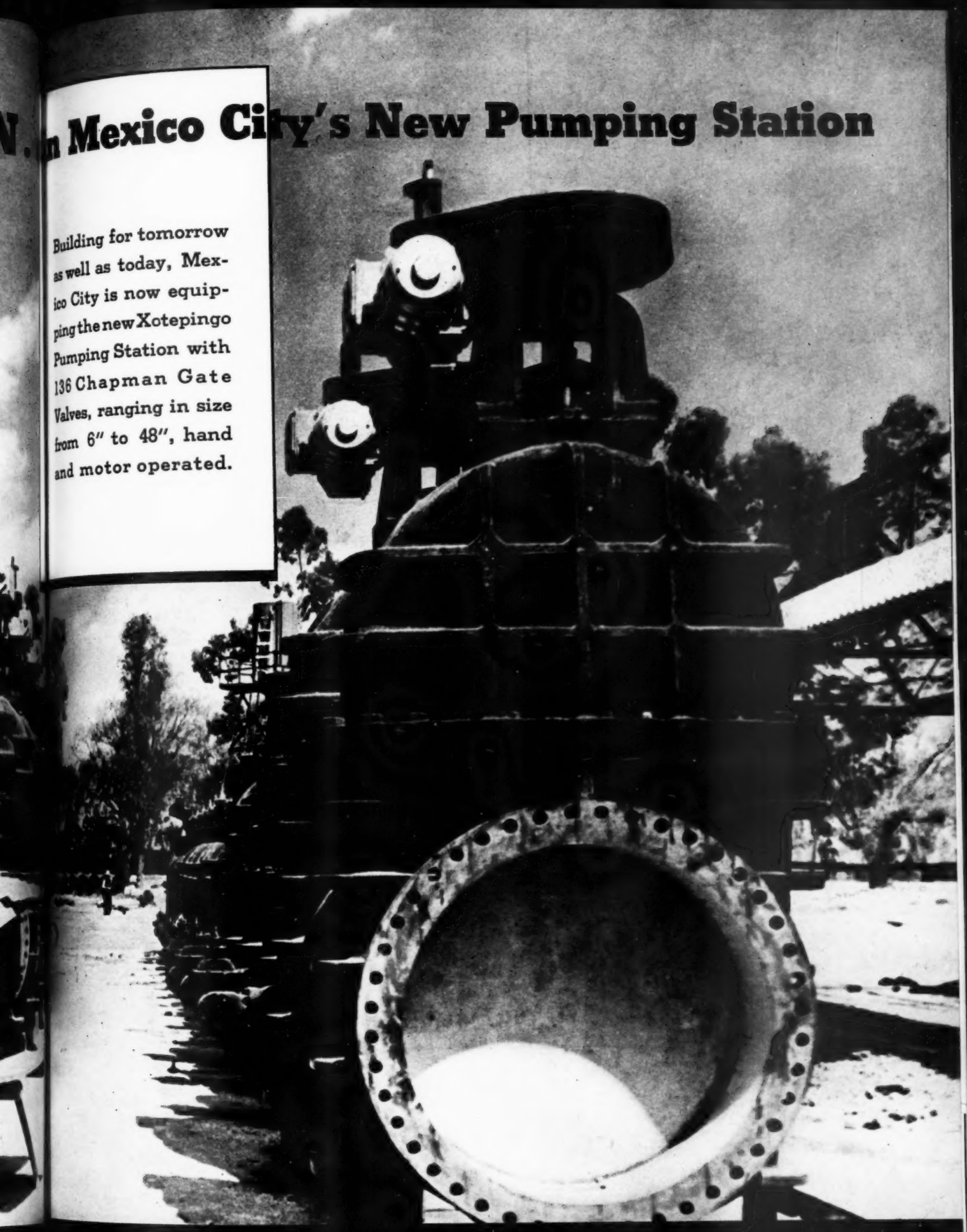

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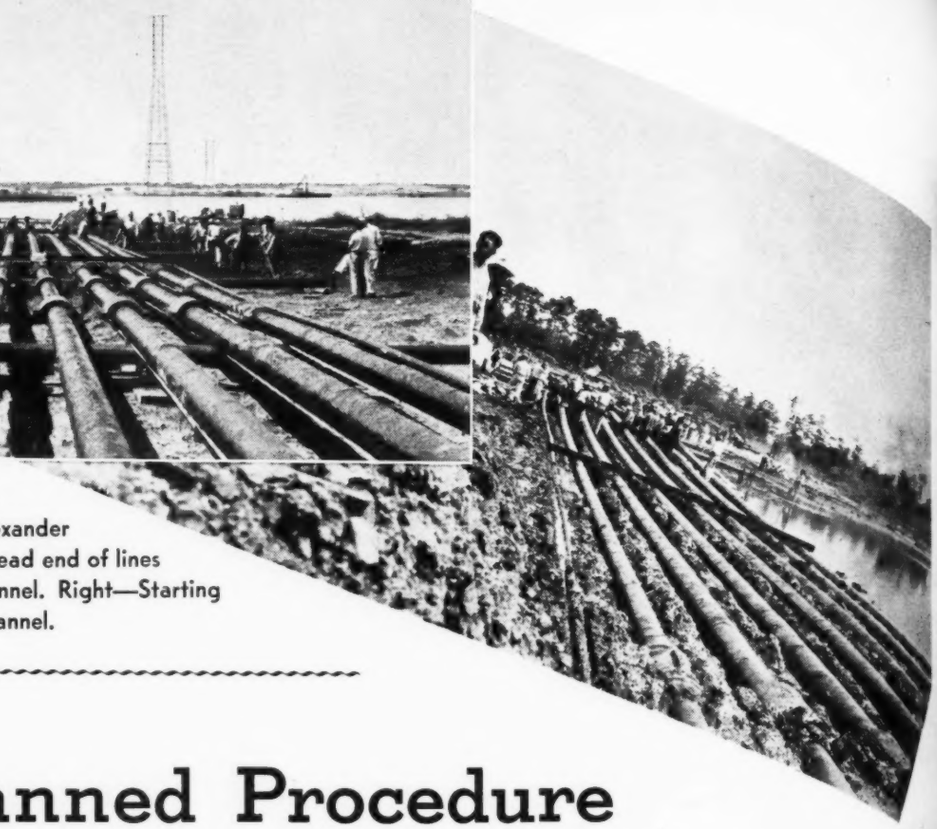

Above—Looking from the Baytown side toward Alexander Island, with the barge and head end of lines about half way across channel. Right—Starting to pull the lines into the channel.

Well-Planned Procedure Facilitates Laying of Channel and Bay Crossings

Eight lines installed across Houston Ship Channel and two across San Jacinto Bay for transportation of crude to Baytown refinery

By
FRANK H. LOVE

PROPOSED deepening of the ship channel at Houston, Texas, has necessitated the Humble Pipe Line Company laying a multiple crossing for delivering crude oil to the refinery of the Humble Oil and Refining Company at Baytown. Previously two 8-in. lines crossing below Baytown and an 8-in. and a 10-in. above Baytown served to transport the crude across the channel. The two 8-in. lines below Baytown were laid in 1920, and shortly thereafter the bottom width of the channel was increased to 150 feet. Since, it has been cleaned out and widened, now being about 200 ft. wide at this point. The proposed channel project is to an authorized depth of 34 ft., which means it actually will be deepened to possibly 37 ft., and to a width of from 200 to 350 ft. at its bottom. Inasmuch as the original two 8-in. lines below Baytown were not at a depth to permit clearance following deepening and widening it was necessary that they be removed and new ones laid. Officials decided that sufficient lines would be laid not only to provide for present needs but also to care for the other two lines and future eventualities. As a consequence, in replacing the two 8-in., eight lines were laid across the navigable part of the channel, consisting of six 10-in., one 8-in., and one 3-in., the latter to serve as a conduit for communication lines.

The eight lines are from the mainland to Alexander Island, a distance of approximately 1600 feet. Across Alexander Island and San Jacinto Bay, the latter not navigable, two 10-in. lines were laid to connect with the existing system. This latter portion of the project entailed the laying of double lines 1.87 miles in length. To complete the project approximately two and a quarter miles of 10-in. line was laid on the Baytown side of the channel to connect the crossing with the refinery at Baytown.

Methods employed in laying the crossing of the channel and San Jacinto Bay provided many interesting features. Government regulations required that the lines across the channel be 45 ft. below mean low tide, and actually they were placed at a depth of 47 feet. Employing a suction dredge, a trench averaging approximately 45 ft. in bottom width was cut from the mainland to Alexander Island. The 47-ft. depth was for a distance of 900 ft. in the navigable part of the channel. At each end of the cut, the slope toward either bank was to a ratio of 3 to 1, i.e., one ft. rise to each three ft. horizontally.

A time record for this type of work is believed to have been established when the lines were laid across the main channel in three and one-half hours. Several weeks, of course, had been consumed in preparing the lines for the pull into the channel. The lines were welded on shore, each being approximately 1600 ft. in length. The strings rested on sections of pipe placed at right angles, the latter in turn being

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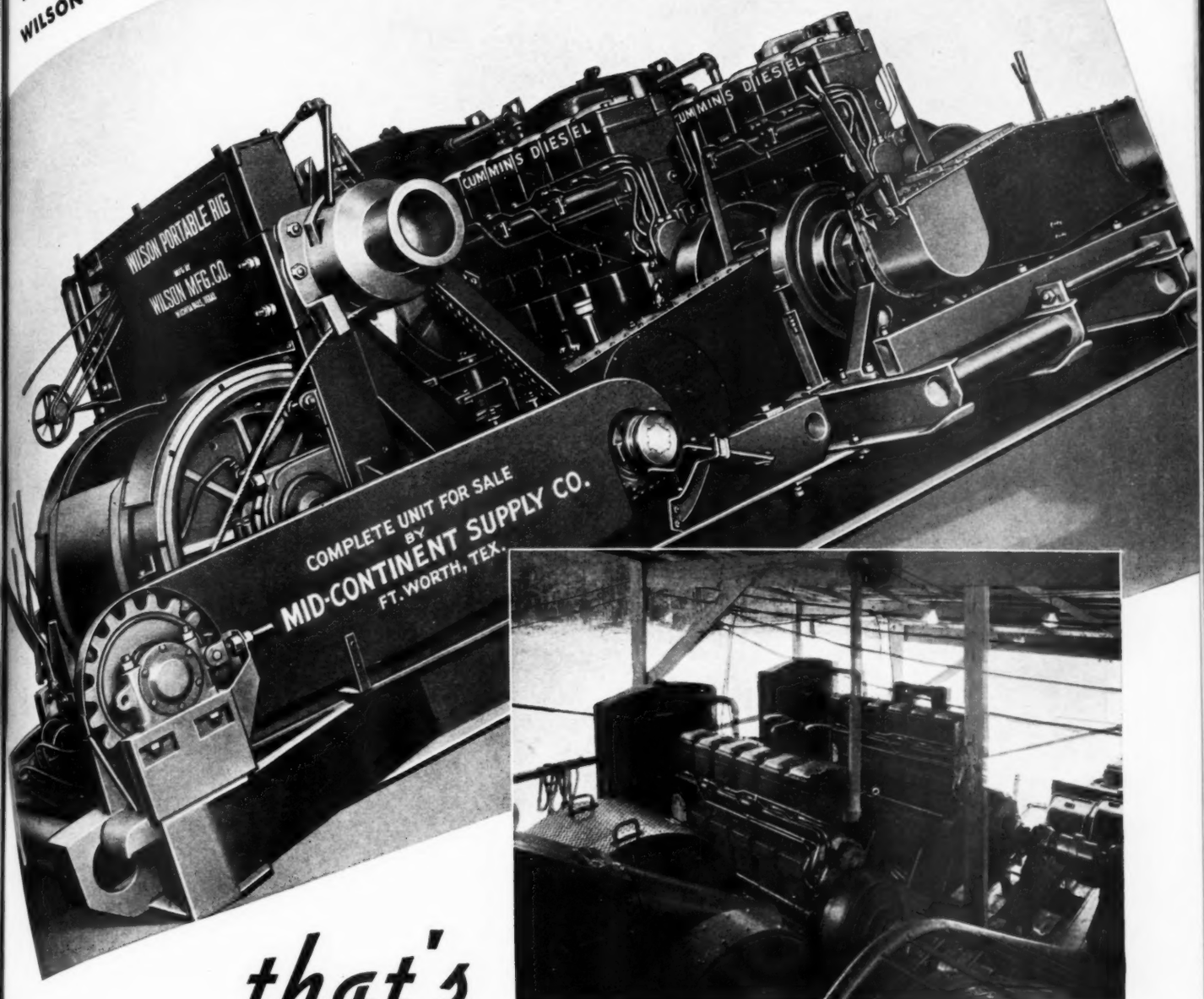

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The lines were carried underneath the barge, being fastened to a framework of pipe secured to the deck

supported by dollies, the pipe and dollies serving as rollers. The eight lines were tied together by means of bridles consisting of angle iron and U-bolts, as shown in an accompanying illustration. The bridles were placed every 70 feet. They can be removed by divers if it is deemed advisable, but for the present are being allowed to remain on the line.

Inasmuch as raising a line from beneath the channel for the purpose of reconditioning or replacing would be a most expensive operation every precaution was taken to prevent corrosion to the pipe. The lines were given a coating consisting of a primer, two applications of hot enamel, a felt wrapper, two additional coatings of hot enamel, an asbestos wrapper, and a final coating of hot enamel. The applications were made on the job rather than in a central yard. To protect the coating while pulling the pipe into the channel strips of board were wired beneath the pipe, running the full length of each string. As the latter was pulled into the channel a crew at the water's edge removed the strips prior to the pipe entering the water. River clamps weighing 600 to 800 lb. each were placed on the pipe to weight it down at the two points where sags were required. An orange-peel weld was made at either end of each string to exclude the water, and, being filled with air, the buoyancy to the pipe was materially increased.

When all was in readiness channel traffic was closed between 10 a. m. and 3 p. m., in accordance with permission granted by the War Department. The ends of the pipe were pulled into the water and fastened to a barge in the manner shown in an accompanying illustration, being brought up underneath and tied to a framework of pipe secured to the deck of the barge. Wire lines fastened to the ends of the pipe extended across to Alexander Island where tractors were stationed. At the outset there were two tractors pulling from the island and four pushing from the mainland. As the work progressed and more and more of the pipe entered the water there were but two tractors pulling and two pushing. The last 70 ft. was pulled by the two tractors on Alexander Island.

So that the workmen on the mainland and the island could coördinate their efforts a set of flag signals was devised. In this manner those operating the tractors on opposite sides of the channel could start and stop them simultaneously, and the various other workmen could adjust their activities

(Continued on Page 64)

Above—At the end of the pull, showing the position of the tail end of the lines on Baytown side

Left—The barge bearing the head end of the lines was about half way across the channel when this picture was taken

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STEEL

Arrangement of dollies and rollers. Note also plank protection strips along bottom of lines to avoid damage to protective coating

Wire lines fastened to the head ends of the pipe extended to Alexander Island where these two tractors were stationed for pulling

dumped on Alexander Island.

Four of the lines have been placed in crude oil transportation service, one (the 3-in.) is used as a conduit for communication lines, and three are spares.

Shortly after the laying of the main channel crossing the two 10-in. lines were put down from Alexander Island across San Jacinto Bay. As this bay is shallow different construction methods were adopted. The pipe was given the same coating as that for the main channel crossing. It was welded into convenient lengths and pushed into the bay, the end supported by a mud barge. Another section was welded on and the pipe carried farther into the bay. This procedure was conducted both from Alexander Island and from the shore. When the two ends met in the middle of the bay they were welded together and lowered.

R. G. Gofner, assistant superintendent of pipe lines, Humble Pipe Line Company, Southern Division, was the construction foreman in charge of the work. The engineering department of the company, under supervision of H. M. Stevenson, chief engineer, worked out the details of the project.

(Continued from Page 60)

to conform. Another interesting factor connected with the work was that in cutting the trench in the channel's bed approximately 165,000 cu. yd. of material was removed, which was

Many Substances Pass Through Bromine Plant

POTENTIAL wealth valued at $96,379,460 at current prices was contained in 158,735,000,000 lb. of ocean water pumped through the bromine plant of the Ethyl-Dow Chemical Company at Kure Beach, near Wilmington, North Carolina, during the last 12 months.

Of these riches from "nature's greatest storehouse of raw materials" only a small part was recovered in the form of several thousand tons of bromine to find its way into the gasoline tanks of millions of automobile drivers and tractor users as a component of Ethyl fluid. The remainder, including $42,000 worth of gold, $29,300 worth of silver, enough magnesium to build 100,000 modern airplanes, and a quantity of common salt sufficient to lay a paving 26 ft. wide and 1 ft. thick from New York to Washington, together with millions of dollars worth of mineral salts and other basic substances, flowed back into the sea via the Cape Fear River.

Two giant electric-driven centrifugal pumps lifted a square mile of seawater 89 ft. deep into the plant during the year. Possible by-products that science has as yet made no serious attempt to extract economically from the ocean occurred in the water as follows:

Sodium chloride, or common salt, 2,140,000 tons, worth $33,200,000 at present market prices. Epsom Salts, 542,500 tons, worth $18,050,000. Calcium chloride, 118,000 tons, worth $2,570,000. Potassium chloride, 61,000 tons, worth $4,880,000. Magnesium, 48,000 tons, worth $33,600,000. Aluminum, 139 tons, worth $58,200. Strontium carbonate, 160 tons, worth $99,600. Iron, 145 tons, worth $17,300. More than three tons of iodine valued at $10,000. Gold valued at $42,000. Silver worth $29,300.

After present construction at the plant is completed July 1, the annual figures will be aproximately doubled, it is announced. With two additional intake pumps working at full speed, the units will pump 137,000 gal. of water a minute at high tide.

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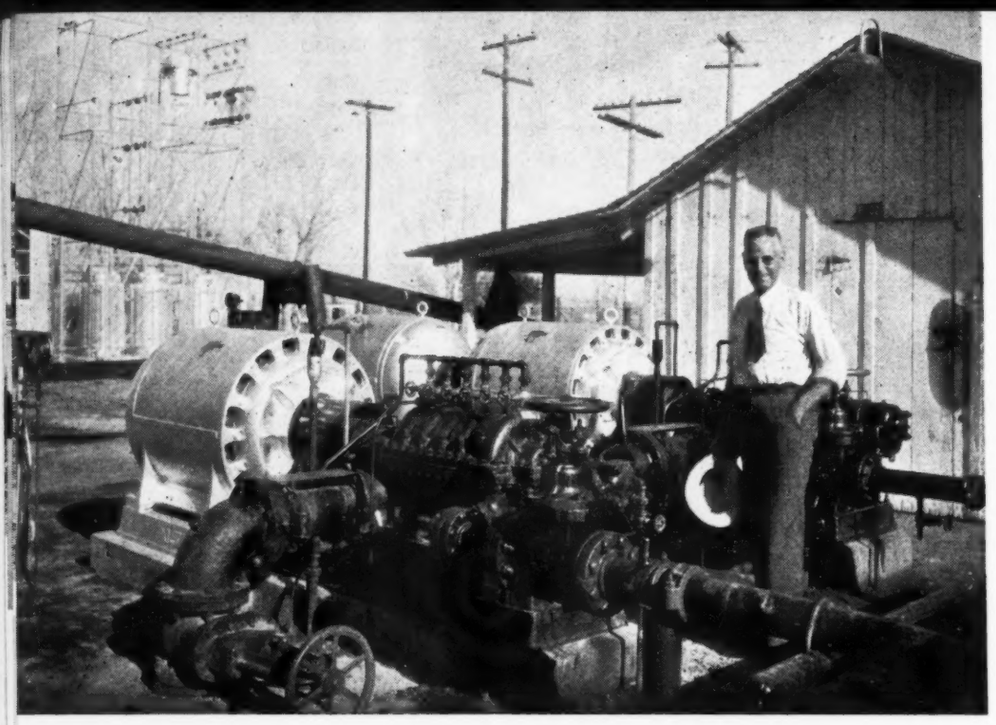

General Pipe Line Company's 600-hp. oil pumping station and electrical substation. In the picture is J. T. Carpenter, electrical superintendent, General Petroleum Corporation

By J. C. ALBRIGHT

Methods Employed in Protecting Pipe Line From Corrosion

Installation of cathodic protection units and application of coatings according to types of soil have proved successful on California line

At the time General Pipe Line Company of California constructed its first major trunk oil pipe line from Kern County to Los Angeles in 1911 and 1912, exterior corrosion of pipe had been encountered in other sections of the country, but little was known definitely about the causes of pitting, other than that certain soils were more active than others. This line was coated with material in general use at that time that apparently arrested corrosion in certain types of soils, but in some areas, the pipe had a pitted surface that indicated deterioration was progressing slowly but surely. Much had been learned concerning the causes of exterior corrosion during the interval between 1912 and 1935, when the company decided to increase the capacity of its transportation system.

A 10-inch line was laid from Lebec, in the Tehachapi Mountains, to General Petroleum Company's refinery at Torrance, near the Los Angeles Harbor. Soil corrosivity was thoroughly investigated, two methods being used to determine where the line should be protected against soil conditions. The Shepard Rod and the Corfield Laboratory Method, the latter known locally as the "Nipple and Can" method, were employed extensively all along the right-of-way. Varying conditions were uncovered, and these governed the method of protecting the pipe against soil corrosion.

Results of the use of the Shepard Rod and the Corfield Laboratory Method, when correlating data on the corrosivity of the soils traversed, indicated that about 40 miles of the right-of-way in the Los Angeles Basin ranged from extremely corrosive to soils that would permit the laying of pipe without protective coating. Maps drawn from the information thus obtained indicated soil conditions in the various areas as being good, bad, or extremely corrosive. The latter two divisions were again sub-divided into three classifications, which were used as a basis for determining the pipe coating that should be applied.

In the areas classified as good soils the pipe was to be laid bare as it was received from the mills. These areas were scattered over the southern portion of the system, ranging in length from one-half mile to three and four miles. The two types of soils classified as bad, and very corrosive also were scattered along the right-of-way, with the longest stretch beginning about two miles north of the Torrance refinery, this stretch having very corrosive soil. This section of the right-of-way crossed what is termed the Montezuma Adobe, and where it was encountered the heaviest wrapping was applied to the pipe before it was laid in the ditch. The non-corrosive soil is what is known as the Ramona Loam, and in it the pipe was laid without wrapping of any kind.

Three types of pipe line coatings were selected, designated as "A", "B", and "C". Grade "A" coating consisted of five applications, as follows:

1. Priming the pipe with Dearborn 2-C Primer.
2. Dearborn XX No-Oxid coating.
3. 15-lb. asbestos wrapper saturated with asphalt.
4. 21/30-penetration, 155/175 deg. fahr. melting point asphalt coating.
5. 30-lb. rag-felt wrapper.

Grade "B" coating consisted of three applications, as follows:

1. Cut-back asphalt primer.
2. Asphalt cover.
3. 21/30 penetration, 155/175 deg. fahr. melting point asphalt coating.

Grade "C" coating also consisted of three applications, but the method differed from grade "B", and is as follows:

1. Cut-back asphalt primer.
2. Asphalt cover.
3. 30-lb. rag-felt wrapper.

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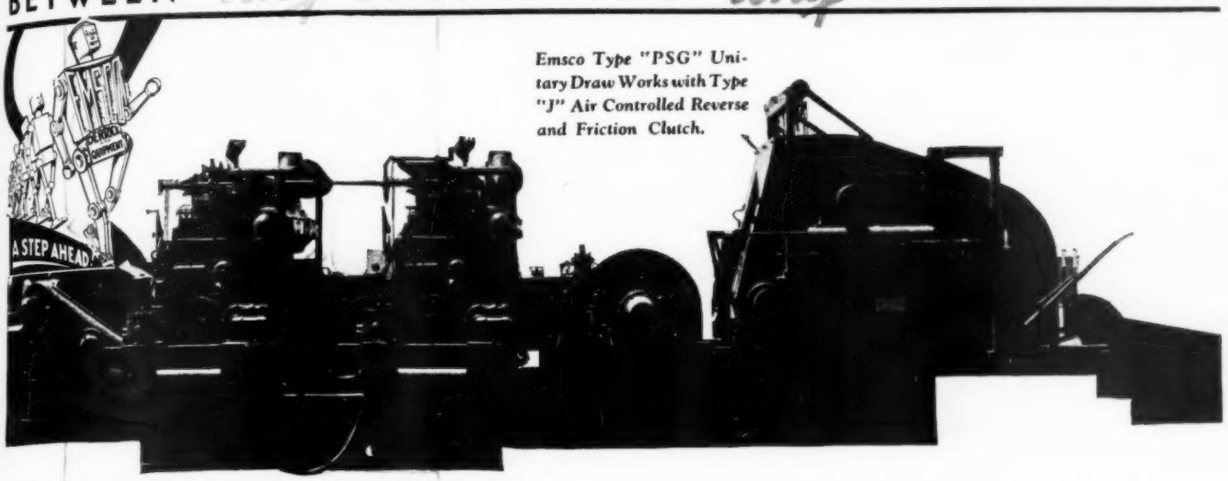
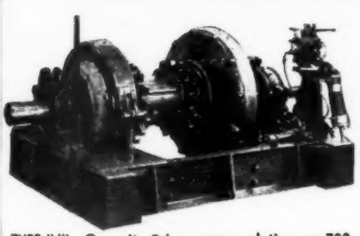
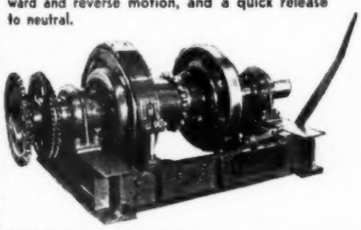


Emsco Type "PSG" Unitary Draw Works with Type "J" Air Controlled Reverse and Friction Clutch.



TYPE "J"—Capacity 2 h.p. per revolution, or 700 h.p. at 350 r.p.m., with an ample factor of safety against slippage. Manual or air control. Emsco Air Control, furnished at option of buyer, provides utmost flexibility and complete simplicity of operation. Hand operated from the driller's position, the air control assures easy engagement for forward and reverse motion, and a quick release to neutral.



TYPE "H"—Capacity 1 h.p. per revolution, or 350 h.p. at 350 r.p.m., with an ample factor of safety against slippage. Manual control. This unit incorporates all the features found in the Type "J," but is a lighter and smaller model.

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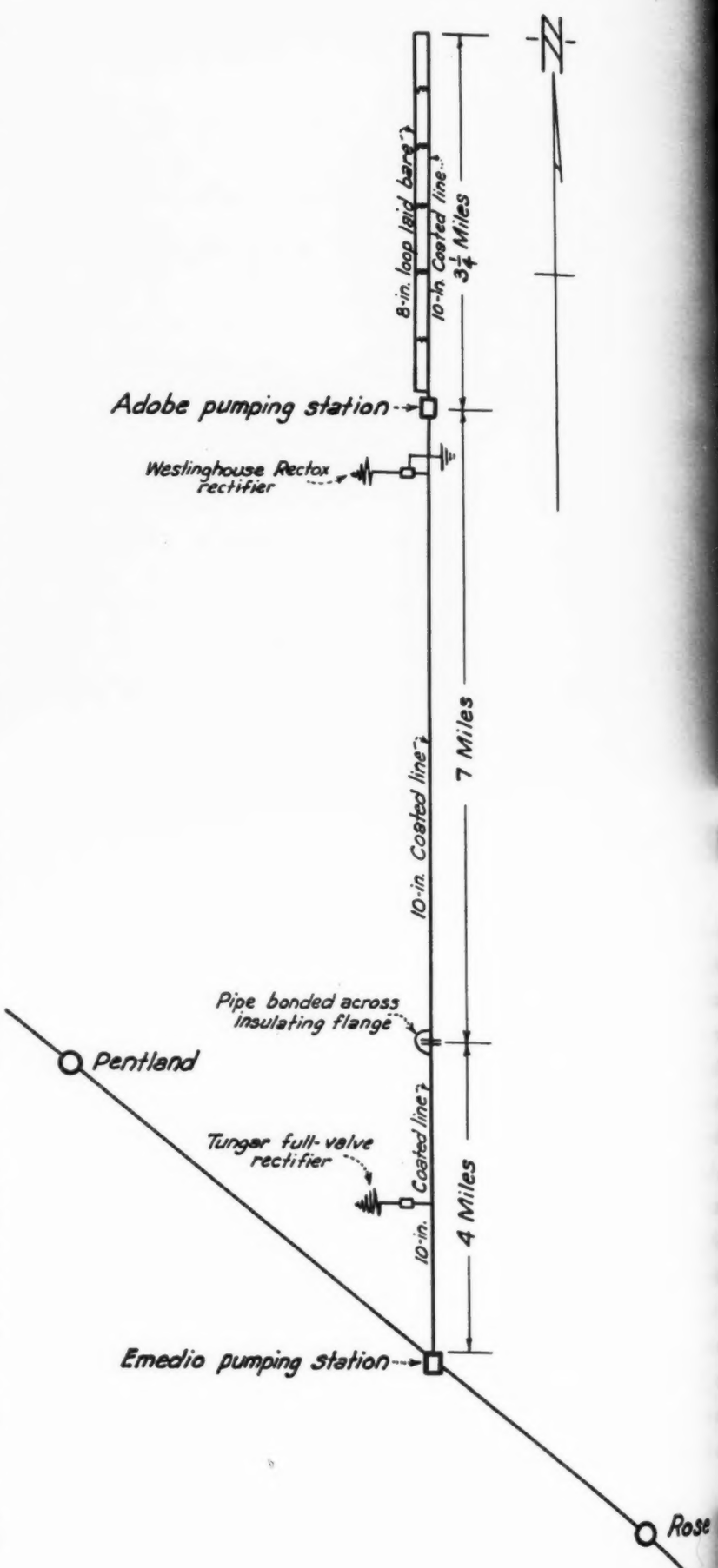
All the pipe coated was trucked from shipside at the docks at Los Angeles Harbor, to the Consolidated Steel Corporation's plant on Slausson Boulevard where it was wrapped by special machines. The ends of the pipe were left bare so that in welding the coating would not be damaged; these welded spots were finished in the field. Abrasions caused by boomer chains and breaks due to rubbing against truck and trailer bolsters also were repaired in the field.

From the Torrance refinery for a distance of two miles no coating was required as the pipe was placed above the ground level on piers and pipe-line supports. The next two miles traversed was Montezuma Adobe, requiring, due to its extreme corrosiveness, that the pipe receive the grade "A" coating. The following 33¾ miles, where the soil was found to be bad to severely corrosive, grade "B" coating was applied; however, several short stretches of Ramona Loam were encountered in this distance and in such spots it was not necessary to give the pipe protection of any kind. Beginning at a point approximately 34 miles north of the Torrance refinery, soil conditions were such that the pipe could be laid with grade "C" coating, but this extended only for a distance of about three-quarters of a mile.

Most of the soils traversed from the "40-mile" stake to Lebec was found to lie within the classification of good soil, excepting numerous right-of-way arroya and canon bed crossings, which required grade "C" coating for protection. Where the pipe line crosses highways, it was cased in the usual manner and wrapped with grade "C" coating.

In the first 40 miles of the line, numerous streets were crossed, as well as interurban and street railway lines. Railroad crossings were made by tunneling and casing the pipe; the 10-in. pipe was placed inside 14-in. casing and the whole boxed with redwood conduits, extending the full width of the crossing. Hot bituminous material was poured into the wood conduits, prepared so that an average of two in. surrounded the 14-in. casing. After the hot material cooled and settled, additional material was poured into each end to fill the voids.

On either side of the electric railway crossings, insulating flanges were used, and the pipe for a distance of



Sketch showing where rectifier units were placed, where pipe was coated, and where left bare

E X-RAY THE "SHOOTING STRING"

never hear of a Lane-Wells Gun-Per-tor being lost in a well or accidentally ating. That is because the 12,000-foot g of steel cable with its core of insulated uctor wire has been pre-tested in every ceivable manner. From the outset, Lane-ls engineers have visualized every pos-e hazard and have devised completely ventive safeguards. When a Lane-Wells n-Perforator is lowered into a well it has itive and proven control going in, firing, in coming out. Every foot of the one-e electric core within the steel cable is n an inch-by-inch X-Ray examination sure against thin or uneven insulation, s, and other defects. The result is that Lane-Wells Gun-Perforating at any depth is as accurate and as dependably controlled as if the job were being done in full view on the surface. In addition to every mechanical precaution you have the field services of our thoroughly experienced "Shooters."

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20 ft. was encased in redwood, provisions being made for about one in. of hot pitch to be poured into the wood casing. Suitable grounds were placed in the soil near the insulating flanges and bonded to the pipe so that stray currents of electricity would be led away and dissipated without causing pitting of the pipe at these crossings.

At the time the soil survey was being made for the new 10-in. line from Lebec to Torrance, surveys also were made on portions of the older systems, north of the Emedio pumping station, which line transports oil from the Mountain View and Bakersfield fields. Pipe that had been in the ground for many years had begun to show advanced stages of external corrosion, indicated by leaks that had become more frequent during the month just prior to the survey. Stripping representative sections of the pipe uncovered a multitude of surface pits, obviously some deeper than others, but the general condition indicating that the line was in such a state of deterioration that it would have to be protected immediately, or else replaced with a new one.

Cathodic protection had been considered by several of the pipe line companies operating in California, but relatively short sections had been equipped with this type of protection. Those being serviced in this manner, however, showed conclusively that successful results were being obtained. Consequently, approximately 15 miles of the old 10-in. from the Emedio pumping station northward was placed under cathodic protection. North of the Adobe pumping station the line previously had been looped with 8-in. pipe and this also showed pitting in a well-advanced stage. The 10-in. line had been covered with the usual pipe line paints when it was placed in the ground, but in the 8-in. loop bare pipe was laid. So closely were they laid to each other the same ditch practically carried the two lines. They were near enough to each other that when protective equipment was installed the lines were bonded together for a distance of about 3½ miles in order that one rectifier could be utilized for both.

One of the 11,000-volt electrical transmission lines of the San Joaquin Light and Power Corporation runs through this territory, from which power is taken to operate the four pumping stations of the General Pipe Line Company equipped with motor-driven centrifugal pumps. Current also is supplied by this system to operate the cathodic protection apparatus. One of the cathodic protection units is at the Adobe pumping station, containing a Westinghouse Rectox rectifier, which is used for the line extending both ways from the station.

Another unit is about two miles north of the Emedio pumping station, where the branch line from Bakersfield and Mountain View joins the main line coming from Kettleman Hills, Belridge, and Midway. Four miles from the Emedio station is an insulating flange, but current supplied by the Tungar full-wave rectifier is carried through the next seven miles by bonding the pipe across the flange. Thus, both the cathodic protective unit on the south and the one at the Adobe pumping station carry the full protective load.

As the cathodic protection devices were installed during the month of April, 1935, sufficient time has elapsed to enable the company to determine the benefits that may have been derived from the application of this form of pipe line protection. Officials of the company have stated that just prior to the installation of the protection stations the stretches of line to which protection was applied were showing leaks at alarmingly close intervals, and replacement of this part of the system was seriously considered. Because of the condition of the pipe, the devices were installed on the worst possible sections of the system with the knowledge that if corrosion were not arrested nothing particularly would be lost; also, if corrosion were arrested, the lengths of pipe line so serviced could be made to serve indefinitely, or at least for several years, as the interior was in good condition. No leaks of any importance have been reported on the protected sections, showing that corrosion had been arrested, if not halted entirely. The cost of maintaining the two stations averages approximately $25.00 a month for purchased electricity.

Thick Belts on Oil Machinery

By W. F. SCHAPHORST

THE excellent illustration shown appeared in Cooper's "Use of Belting" published almost 50 years ago. It is being reproduced here because it shows so clearly the action of a thick belt on a small pulley. By means of stiff and inelastic blocks of the shape indicated the illustration shows the change in length that is continually going on in a belt as it passes around a pulley. The spaces a, b, c, d, e, f, and g, added together, equal the total stretch of the outer belt fibres. At the same time the inner fibres are compressed by a similar amount, the blocks "closing up", as shown. The heavy central black line is the "neutral axis", the only portion of a belt that does not change in length.

The illustration makes plain the reason why belt thickness should always be considered when computing pulley and belt speeds for oil machinery. The old rule that says belt speed is directly proportional to pulley diameter is not correct. For exact computations use this formula:

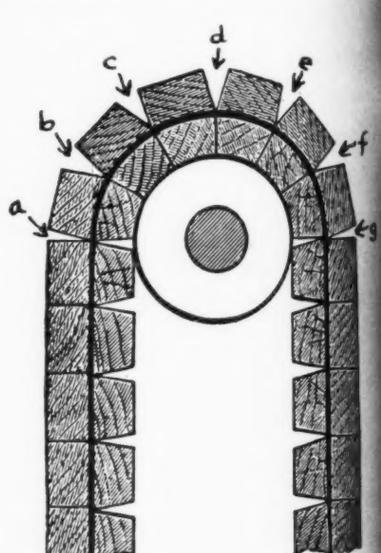
$$n = N\frac{(D\ t)}{(d\ t)}$$

Where

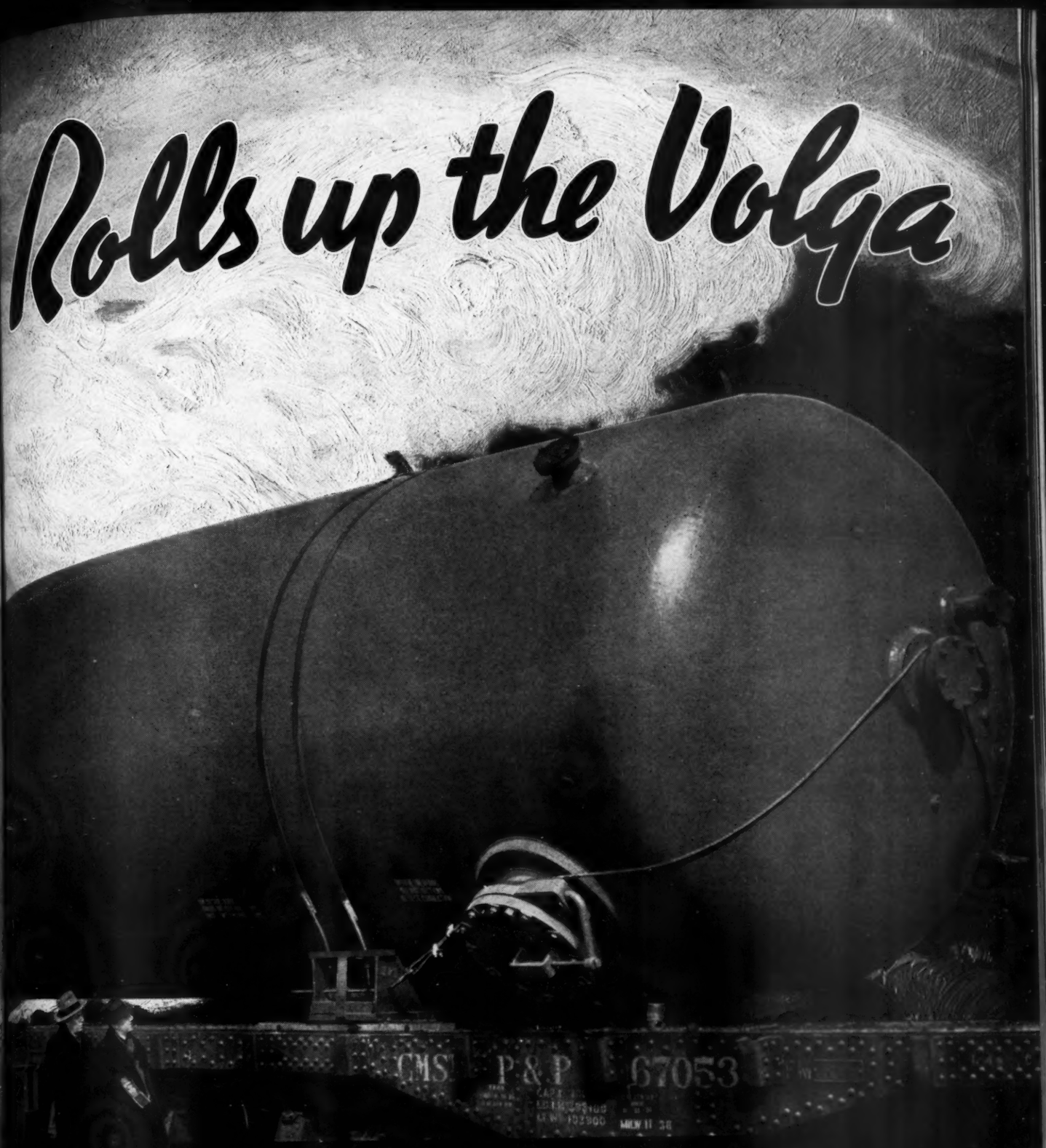
n = r.p.m. of driven pulley
N = r.p.m. of driving pulley
D = dia. of driving pulley, in.
d = dia. of driven pulley, in.

Or, eliminating the algebra and putting it entirely in words, we have this correct rule:

Add the thickness of the belt to the diameter of the driving pulley, both in in., multiply by the r.p.m. of the driving pulley; then divide by the sum of the belt thickness and diameter of driven pulley, both in inches. The result will be the r.p.m. of the driven pulley.



Rolls up the Volga



THE famous Volga Boatmen will soon see a strange sight: this huge Smith Pressure Vessel floating up the river and its tributaries—1900 miles from Leningrad to the town of Ufa in the Ural Mountains.

Too large and heavy to be carried by river boat, it will be closed airtight and dumped off the ocean steamer at Leningrad, then towed by small craft through the inland waterways of U. S. S. R.

This Smithwelded and Smithlined Evaporator for oil cracking is one of the largest vessels ever built, all dimensions considered. The inside diameter is 12 feet, the wall thickness is 2 3/8 inches and the over-all length is more than 91 feet.

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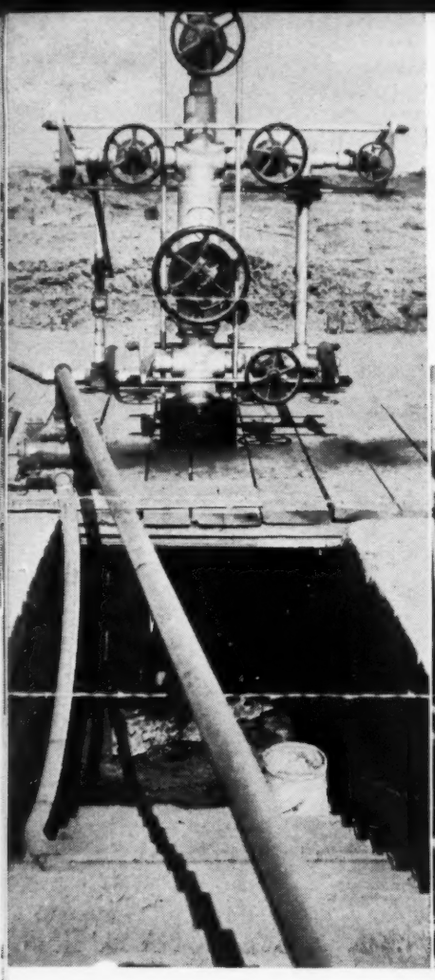
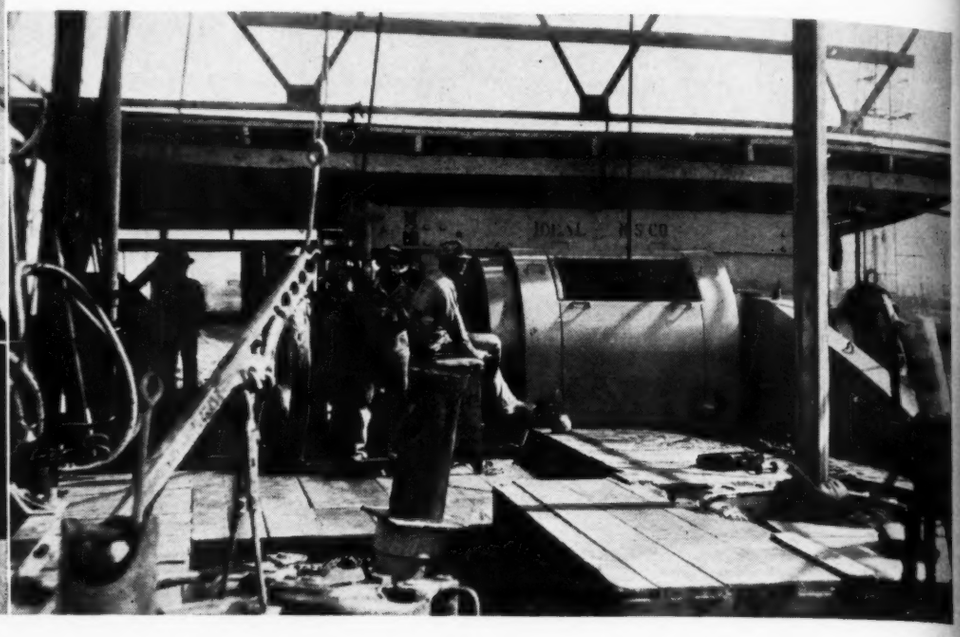


Left: A typical well-head installation in the new deep development, Jennings field. This photograph, taken at A. C. Glassell's No. 1 G. Truschell heirs, emphasizes the construction of the concrete well cellar, a necessity in this field to overcome slumping at the surface.

Below: On the derrick floor of one of the wells.



Deep Development Practice in Jennings Field, Louisiana

In this active field of coastal Louisiana, drilling operations are marked by numerous interesting features.

By JOS. A. KORNFELD

NEW deep development operations in progress on the west, southwest, and south flanks of the Jennings oil field in Acadia Parish, Coastal Louisiana, are marked by several interesting features.

Wells have massive concrete cellars and foundations; these are necessary to prevent serious slumping. Extremely heavy-duty drilling equipment is employed. Besides the difficulties of crooked holes attendant to flank drilling, development is highly competitive and wells are closely spaced; in addition the productive rim of the salt dome is not very wide.

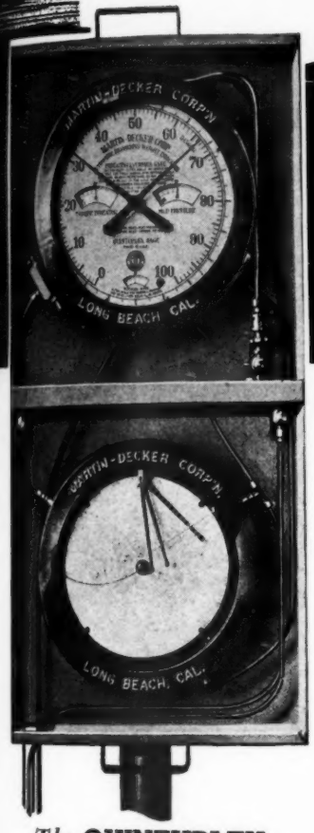
Drilling practices include the use of separate rotary table drive and the installation of double drawworks to reduce shutdowns. Both gun-perforation of casing and perforated liner are used in the selective completion of wells. The swampy condition of the area necessitates board roads and the use of tractor-wheel trailers for hauling the casing.

In this area, considered the most active in Coastal Louisiana at the moment, only one failure has occurred compared with seven successful completions, a remarkable record considering the steep dip of the flanks of this piercement-type salt dome. All completed oil wells are producing by natural flow.

Drilling activity in the field received its impetus on September 24, 1936, when Superior Oil Company's No. 1 William G. Leckelt cored richly-saturated oil sand in the Marginulina series of the Oligocene, indicating the possibility of deep oil production on the west flank of the dome. Previously, all flank production had been confined to the southeast, overhang cap-rock sector of the dome, where eight oil wells had been completed in the Oligocene since June 2, 1929.

In many respects development of the west and adjacent flanks at Jennings have been accompanied by modern engineering methods. The wells range in depth from 5480 ft. to 7100 feet. To date, seven flowing oil wells, and one gas well have been brought in; one oil well has been abandoned, and there are eight drilling operations in progress.

HERE COMES *tomorrow!*



The **QUINTUPLEX**

Fully aware that tomorrow's tools are products of today's research guided by yesterday's experience, Martin-Decker looks to the future with confidence.

Pioneers in scientific drilling and production control instruments, Martin-Decker is not content to rest on its laurels. By constant research, guided by knowledge gleaned from the past, we shall continue to maintain the Martin-Decker name as a symbol of leadership in the scientific development of oil field technique.

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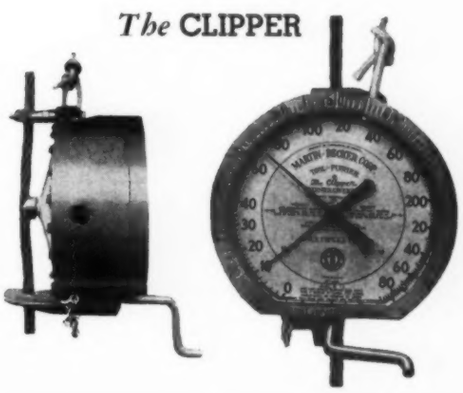
CEMENT and MUD PUMP GAUGE for measuring and recording fluid pressures.

MEASURING LINE WEIGHT INDICATOR that accurately measures the tension in moving lines.

Rotary Table Tachometer . . . Cable Tension Indicator . . . Pump Dynamometer . . . Pull Rod Dynamometer . . . Gauge Pulsation Damper . . . Depth Pressure Recorder.

The **CLIPPER**



Do You Know?

Corrosion costs the oil industry of the U. S. A. $125,000,000 per year.

THE WEIGHT INDICATOR

MARTIN-DECKER CORPORATION

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High slush-pump pressures demand efficient desanding of the drilling mud. A battery of three mechanically-driven, electrically-powered desanding devices

Perforated liner was used in completing the west flank discovery well. After setting and cementing the 7-in. production casing at 6342 ft., the Superior Oil Company ran 49 ft. of 4¾-in. blank liner and 17 ft. of perforated liner. Tubing, 2½ in. in diameter, was suspended at 6060 feet. Initial production for the first 12 hours was 278 bbl. through a 11/64-in. choke. Pressure on the tubing was 1225 lb., and on the casing 1350 pounds. Gas production accompanying the oil flow was estimated at 250,000 cu. ft. daily. The total depth of the well is 6380 feet.

Relationship of the new flank discovery to the previously-developed shallow-cap-rock production is shown in a resume of the dome's discovery and development. The field was discovered in August, 1901, eight miles northeast of the town of Jennings, the first oil-producing area in Louisiana, when Jennings Oil Company's No. 1 Clement in section 46, township 9 south, range 2 west was completed in the Pliocene at a depth of 1882 feet. During development of the shallow production 630 tests in all were drilled on the crest of the dome and on the southeast overhang, of which 520 proved to be commercial oil wells. To date, more than 300 acres have been proven for oil production, exclusive of the new Oligocene production on the west, southwest, and south flanks.

Cumulative oil output to January 1, 1936, was 51,566,991 barrels. Today the shallow production consists of 45 wells producting in excess of 1610 bbl. daily. Presence of a prominent surface mound and gas seepages led to prospecting on the dome.

The geologic structure of the Jennings field is a piercement-type salt dome with cap rock found at depths ranging from 2000 ft. to 4300 feet. Present flank development, confined to sections 40, 41, and 42, follows the 4300-ft. cap-rock contour.

The most difficult engineering problem was to prevent the settling of rig foundations. The seriousness of the problem was revealed in the fact that at Superior Oil Company's No. 3 William G. Leckelt, on the west flank of the dome, the contractors found it necessary to use 100 sacks of cement on top of the cellar to prevent further settling of the foundation. Previously 11¾-in. surface casing had been set at 1587 ft. using 300 sacks of cement.

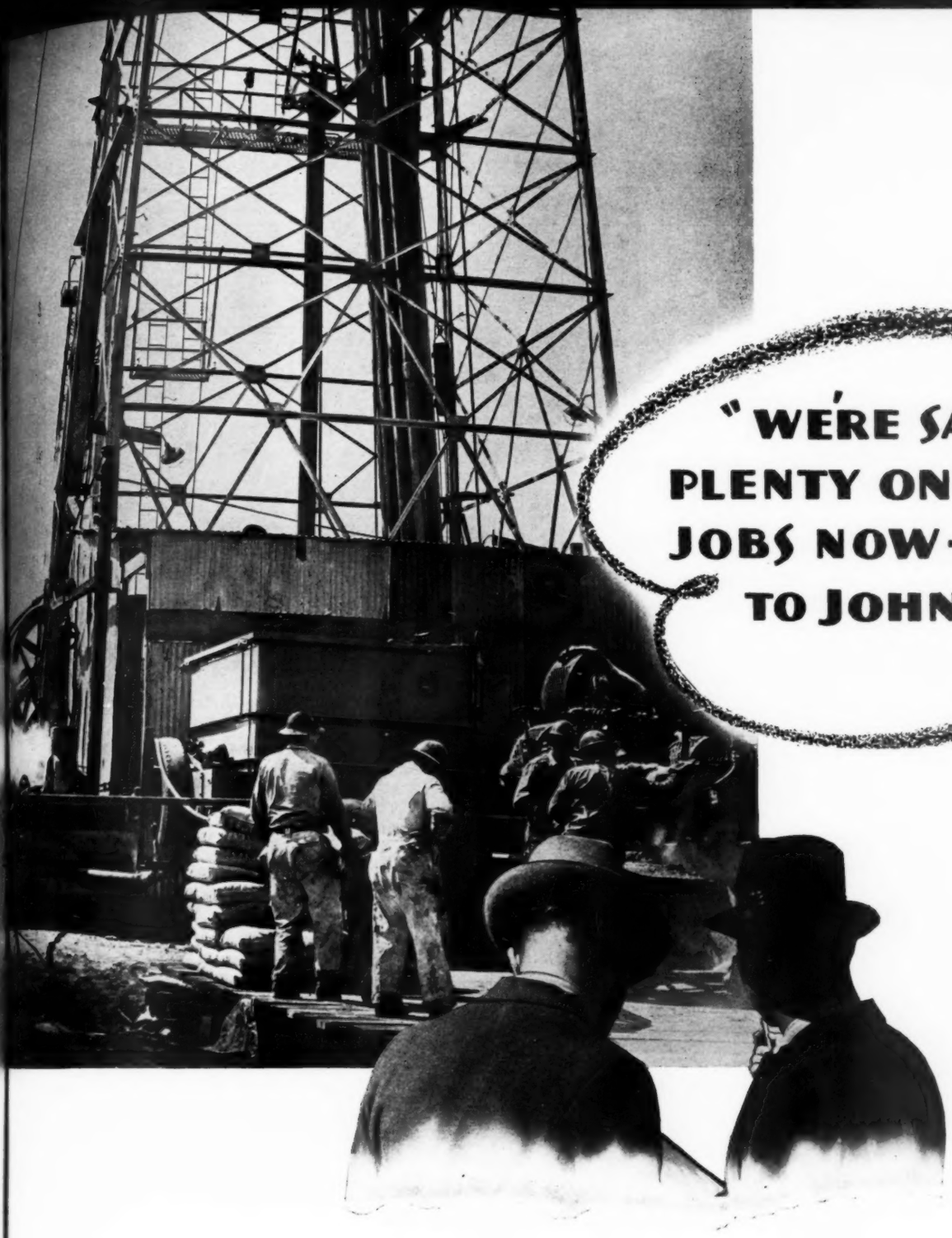
The same difficulty was encountered at the south offset, Glassell & Glassell's No. 1 Gus Truschell heirs, and led to the construction of a concrete cellar as shown in an accompanying photograph. The foundations began washing out and first were noticed while contractors were digging the rat hole. After setting the 13-in. O. D. 40-lb. 8-thd. seamless surface casing at 1580 ft. and cementing with 750 sacks, special cement, 277 sacks, was required around the top of the surface pipe in cellar construction to prevent further settling. This procedure has been adopted by Glassell & Glassell and Superior Oil Company. Five days are required to build the concrete structure and erect the steel derrick.

The setting of a protection string of casing is practiced on some wells in the field. At Superior Oil Company's No. 1 Eunice Crowley, operators set 9⅝-in. 36-lb. standard seamless Grade C casing at a depth of 4202 ft., using 200 sacks of cement. On Superior's No. 1 Jennings-Heywood in section 41, 9⅝-in. 36-lb. standard seamless Grade C casing was set at a depth of 4446 ft. with 250 sacks of cement. Stanolind Oil and Gas Company's No. 18 Housierre-Latrielle in section 47 set the 8⅝-in. protection casing at a depth of 5358 ft., although the 6⅝-in. oil string was set at a depth of 7005 feet.

As the sand is unusually thick, the casing is gun-perforated. On Superior Oil Company's No. 1 Jennings-Heywood the 5-in. casing was gun-perforated with 60 holes from a depth of 6460 ft. to 6520 ft., resulting in an initial production of 517 bbl. of oil daily with only 0.2 percent water. The gas volume was 230,000 cu. ft. daily.

The 7-in. casing at Superior Oil Company's No. 1 Eunice Crowley was gun-perforated with 35 holes from 5480 ft. to 5490 feet. Initial production was 506 bbl. of pipe line oil daily, accompanied by 350,000 cu. ft. of gas. The same size casing was gun-perforated successfully at Superior's No. 1 Iowa-Jennings from 6352 ft. to 6484 feet. The resultant production was the largest initial flow of any flank Oligocene well on the west side of the dome, being 711 bbl. of oil daily, with 0.2 percent basic sediment. The gas volume accompanying the oil was 344,000 cu. ft. daily. Use of the gun-perforator aided in controlling the volume of gas to flow the oil at an efficient gas-oil ratio. In the remaining flank Oligocene oil wells 5-in. 15-lb. to 30-lb., and 4¾-in. 16-lb., liners were used. In two producers 6⅝-in. and 7-in. casing and conventional screen were used.

Superior Oil Company's No. 1 William G. Leckelt, the discovery well on the west flank that resulted in an intensive drilling campaign



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Johnston Testers are available for every oil field in the world. Contact the nearest office for complete information.

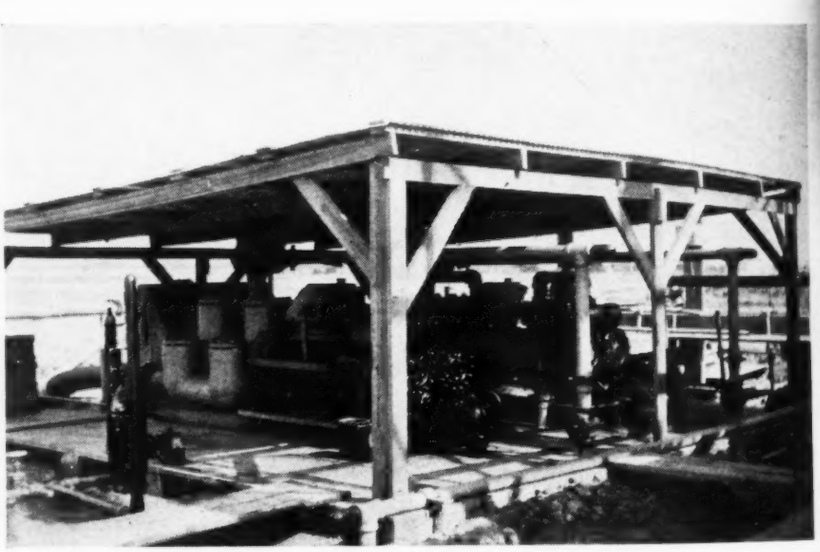
"WHY SET CASING BEFORE YOU KNOW?"

BASIC DATA—DEEP DEVELOPMENT—JENNINGS OIL FIELD—ACADIA PARISH, LOUISIANA

	Superior Oil Company										Glassell and Glassell		W. T. Burton	Shell
	Wm. G. Leckelt 1	Leckelt 2	Leckelt 3	Leckelt 4	Crowley 1	Crowley 2	Jennings-Heywood 1	Jennings-Heywood 2	Iowa-Jennings 1	A. P. Moresi 1	G. Truschell Heirs 1	Truschell 2	Robera 1	Conover 2
Casing Record														
Surface Pipe	1205 ft. of 13⅜-in. 52-lb.		1587 ft. of 11¾-in.	1549 ft. 11-in.			4445 ft. 9⅝-in. 36-lb.		1970 ft. of 11¾-in. 54 and 45-lb. seamless pipe	1523 ft. of 10¾-in.	1677 ft. of 10¾-in.	1780 ft. of 13-in.		
Protection String					4202 ft. of 9⅝-in. 36-lb. seamless									
Oil String	6342 ft. of 7-in.				5614 ft. of 7-in. 28-lb.		6743 ft. of 5-in. 18-lb.		6484 ft. of 7-in. 28-lb.		6925 ft. of 7-in.			
Status of Well	Oil Well	Abandn'd Oil Well	Drilling	Drilling	Oil Well	Oil Well	Oil Well	Oil Well	Oil Well	Drilling	Oil Well	Drilling	Drilling	Gas Well
Initial Oil Production (Daily)	556 bbl. (11/64-in. choke)	160 bbl.			506 bbl.	232 bbl.	517 bbl.	527 bbl. (15/64-in. choke)	711		504			
Gravity of Crude	38.3 deg.	40.4 deg.			39.7 deg.	25.9 deg.	39.8 deg.	39.2 deg.	38.1 deg.		38.3 deg.			
Pressures (orig.)	1225-lb. 1350-lb.						2000-lb. 2450-lb.							
Tubing Pressure	1000-lb.	450-lb.							1450-lb.		1400-lb.			
Casing Pressure	1900-lb.	875-lb.							2550-lb.		1100-lb.			
Gas Production	308*				350*	230*			344*					
Total Depth	6380 ft.	8329 ft.			6448 ft.	6759 ft.			6484 ft.		7018 ft.			7355 ft.
Depth of Sand	6352–6367				5480–90 5510–30				6352–6484	6724–6928	6772–7018		6700–6800	
Plug-back depth		6877												

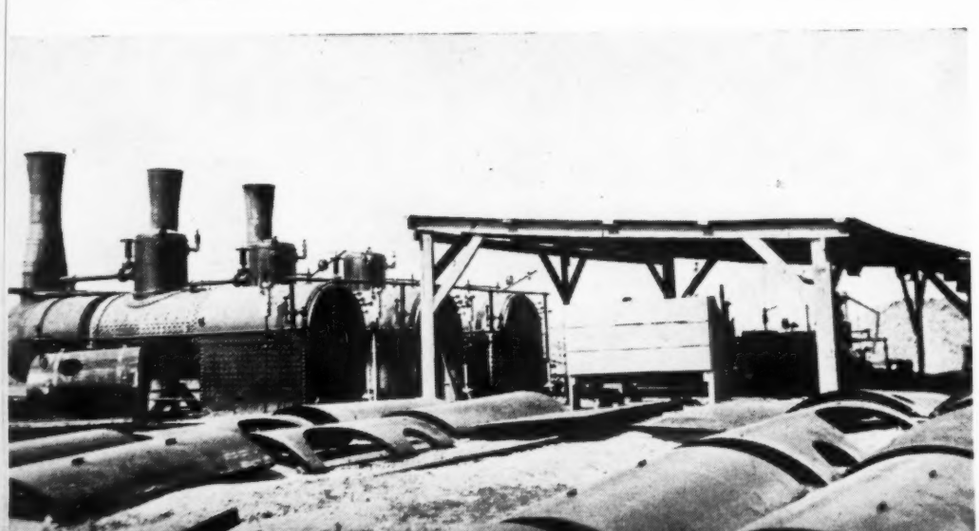
*Thousand cubic feet

The casing program adopted last fall consisted of the use of 9⅝-in. 36-lb. seamless Grade C casing as the protection string, landed at depths ranging from 4402 ft. to 4445 ft. and cemented with 250 sacks of cement. This practice was changed in the late spring of this year to eliminate the protection string and utilize a longer string of surface casing. This necessitated setting 11¾-in. 54-lb. and 45-lb. standard seamless Grade C casing to depths ranging from 1523 ft. to 1677 ft., using 250 sacks of cement. The oil string is of 7-in. 28-lb. standard seamless Grade D casing set at depths ranging from 5614 ft. to 6925 ft., depending on: (a), position of well on the periphery of the dome, (b) extent of penetration of producing sand and, (c), whether casing is to penetrate the saturated sand and gun-perforation employed, or is to be set on top of the sand and screen and/or perforated liner used.



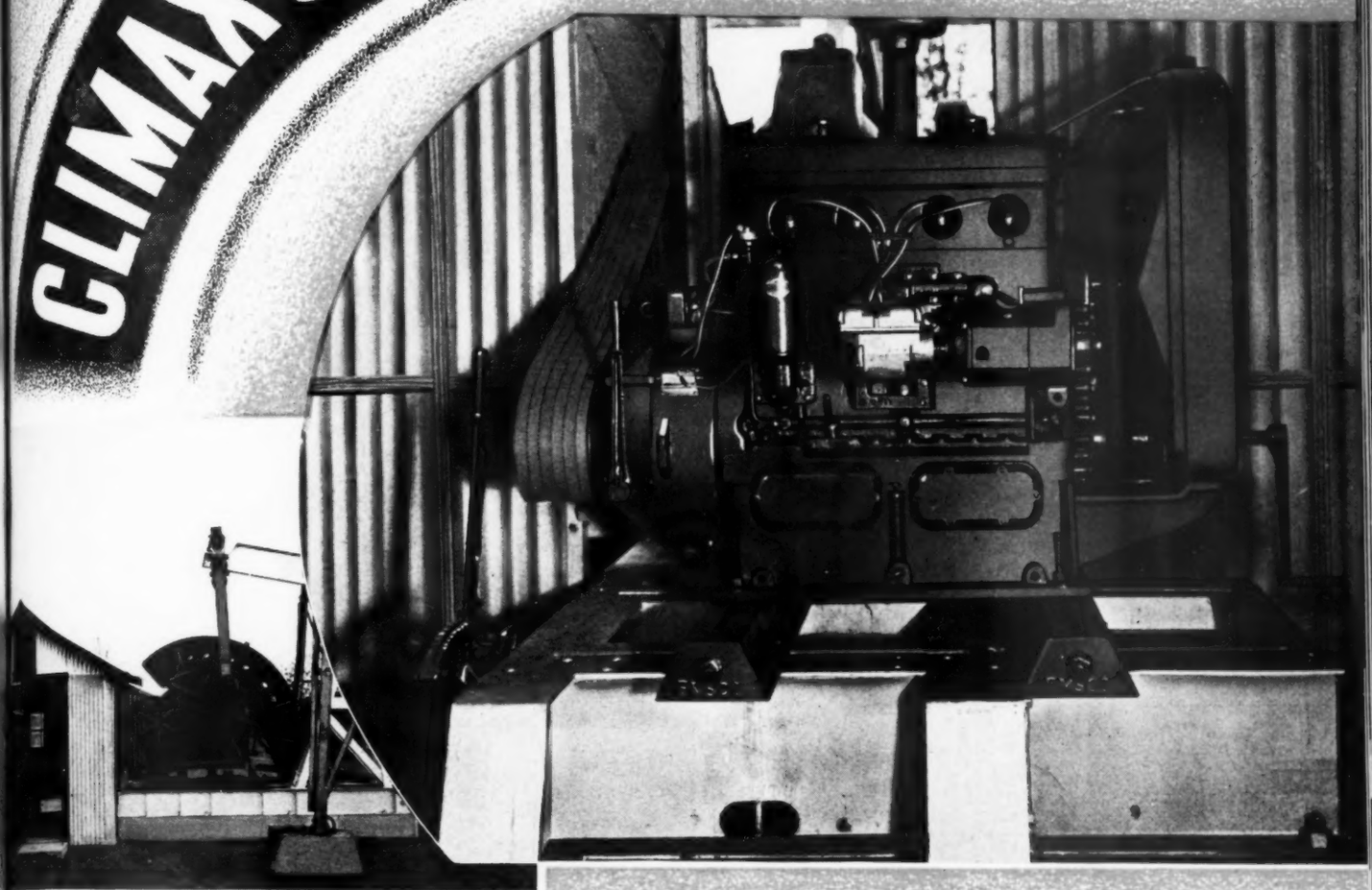
Heavy slush pumps, as shown here, are in general use in the field

Coring practice includes the use of the wire-line barrel from a depth of 5570 ft. until the Oligocene Marginu-



The boiler plant shown here is typical of that used in the field

CLIMAX Blue Streak ENGINES



18JT-10CDS Continental-Falk Pumping Unit powered by G4C Climax Engine shown above.

Model G4C Climax Blue Streak Open Box Base Type Pumping Engine in operation.

Blue Streak is Showing the Way to Lower Lifting Costs

The Open Type Model G4C Climax Pumping Unit with Box Base embodies the best in engine design for meeting the increasing demands of oil field service.

Adaptable for use with natural gas, gasoline, butane, distillate or kerosene fuel, with a size range from 20 to 200 h.p.—there's a Climax for any pumping job.

Complete in every detail—oil filter and oil bath type air cleaner insure proper lubrication at all times. Special safety devices automatically stop the engine in case of water or lubricating oil failure.

More and more Climax *Blue Streak* Engines are taking the place of other types of pumping engines in every field. Adequate stocks of Engine Units and repair parts are maintained at convenient Continental store points throughout the Mid-Continent.

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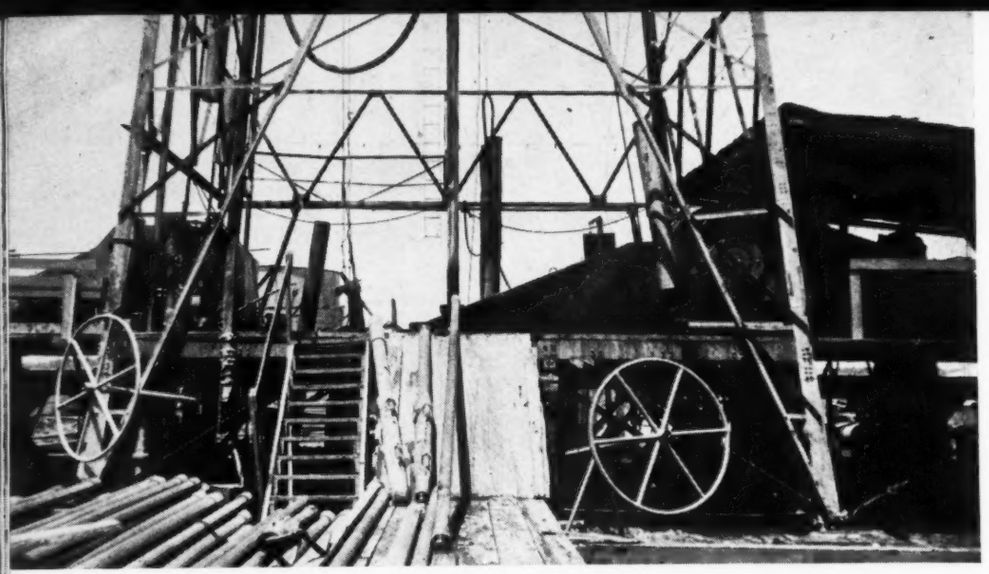


Use of a double drawworks is standard practice in the field

lina sand is reached. At that point, the standard core barrel is used.

More than ordinary attention is given to correct weights and viscosities of drilling mud, including the proper addition of tannic acid and caustic soda for controlling viscosity. In Superior Oil Company's No. 3 William G. Leckelt on the west flank 10-lb. mud of 20 to 24-point viscosity was used until a depth of 5140 ft. was reached. At that point, the weight of the mud was increased to 11.5 lb. and the viscosity reduced to 20 points.

Several batteries of three mechanically-driven, electrically-operated desanding devices are in use in the field. Power is provided by three motors, each of 2-hp. capacity, operating at 1750 revolutions per minute.

Inasmuch as the development is on steeply-dipping flanks of a shallow salt dome, the verticality of the hole is checked frequently. Several types of devices are employed for this purpose. The Superior Oil Company follows the practice of running an acid bottle each time the pipe is pulled from the hole. Below 4000 ft., the hole is surveyed for verticality as frequently as circumstances may dictate. On the southwest flank the hole is surveyed at intervals of approximately 800 ft. from 200 ft. to a depth of 4300 feet. From that depth to the bottom of the hole checking at intervals of 200 ft. is common practice.

Rapid drilling also is a feature of the new flank development. The west flank discovery, Superior's No. 1 Leckelt, was drilled to and completed at 6484 ft. in only 45 days. Fifty-nine hundred ft. of hole was made in 35 days at Glassell & Glassell's No. 2 G. Truschell heirs. At their No. 1 Robert McFarland, 900 ft. of hole was made in 24 hours above a depth of 3000 feet. This fast time also features the drilling operations of two new rigs costing $140,000 each owned by Glassell-Rodgers Drilling Company. The 14 by 14 drilling engine is operated at a steam pressure of 300 lb. supplied by three 125-hp. boilers. The drawworks have a 9-in. jack shaft and 11.5-in. drum shaft, driving a 27-in. rotary table. Swivel and traveling block are of 300-ton capacity. Two 20-in. slush pumps, equipped with 8.5-in. liners develop 500-lb. pressure at 144 strokes per minute. Boiler feedwater is handled through two 10 by 4.5 by 10 pumps mounted on steel skids. In connection with the use of hydromatic brake, a 50-bbl. water supply tank is mounted on a wooden standard adjacent to the rig-floor. Ninety gal. of water per minute are circulated to cool the drawworks drum. Drill pipe, of 5-9/16-in. diameter, is used on the No. 1 rig on the Truschell heirs fee, while 4.5-in. drill pipe is employed on No. 1 Robert McFarland.

Unusual speed also featured the drilling of Superior's No. 1 Iowa-Jennings, drilled in 57 days. Glassell & Glassell's No. 1 Truschell heirs was drilled in 59 days.

Steel derricks used in the field are 136 ft. high, with a 30-ft. base. Several derricks in the field are capable of withstanding an 800,000-lb. load without reinforcing.

Equipment of the latest type for controlling high pressures is a part of the heavy-duty rigs owned by the Glassell-Rodgers Drilling Company. All cellar controls are centralized within easy reach of the driller, and are hydraulically-operated. Grouped in line these controls, placed on the derrick-floor near the drawworks control, have separate controls for handling the blow-out preventer, the 7-in. flow line, and the master gate. A 2-in. water line is connected to the boiler-feed pumps and a pressure of 300 lb. is maintained at all times on the control system in the cellar.

Petroleum Refining in Australia

WITH a view to decreasing dependence on foreign sources of mineral oils and preventing foreign control of the domestic market, the Australian government formed with the Anglo-Persian Oil Company, Ltd., on May 14, 1920, a company known as Commonwealth Oil Refineries, Ltd., for prospecting and drilling for petroleum, for refining crude oil, and for the sale of refined products.

In pursuance of its agreement to construct a refinery the Commonwealth Oil Refineries, Ltd., opened in 1924 at Laverton, near Melbourne, a plant with horizontal stills. A pipe still was added in 1932. Its capacity, 426,780 bbl. a year in 1930, was rated at 900,000 bbl. at the end of 1936. The Laverton refinery operates on Iranian crude, from which it makes gasoline, kerosene, Diesel oil, and fuel oil.

The largest refinery is operated by the Shell Company of Australia, Ltd., at Clyde, near Sydney, N. S. W. This plant, built originally by John Fell & Co., Ltd., to treat oil shale from Newnes and later converted to treat imported crude, was purchased in 1925 by the Shell. The plant, with a capacity of 711,300 bbl. yearly in 1930, operates on crude petroleum imported chiefly from Netherland India, with a little from British Borneo, and the United States.

The Newport Oil Refinery, Ltd., of Newport, Victoria, has a small plant refining unfinished lubricating oils purchased from the Shell Oil Company of Australia and for running small quantities of crude petroleum obtained from wells in the Gippsland district of Victoria.

The Commonwealth Oil Refineries cannot be said to have been strikingly successful in achieving its objectives. No production of crude petroleum in Australia or New Guinea has been obtained. By 1932 it was supplying only 6.5 percent of the gasoline demand of the Commonwealth, in part from imports. It had not succeeded in preventing domination of the market by the importing companies.

Reducing Loss of Lubricating Oil in a Pipe Line Station » » »

Accumulation of oil about pumps led to an investigation that resulted in a faulty operating condition being corrected

By ELTON STERRETT

WASTED oil, lying in tiny drops around the pump foundation and gathering in puddles within the frame on each unit of a battery of plunger pumps was wiped up periodically by the oilers in the station without curiosity being aroused as to "why" the oil was in those spots.

The lubrication of crosshead pin was accomplished in the conventional manner with a sight feed oiler mounted on the frame, and tube and wick distributor arranged so as to be contacted on each stroke by the collector on the crosshead. Usual practice at this station was to feed one and one-half pints of oil through this cup each 24-hour run.

Hanging a sheet of paper outside the path of the system soon showed that the wasted oil was being spattered—some of it, at least—as the collector struck the drop of oil gathered or formed at the center of the sag in the wick. Further watching revealed that some oil was forming into droplets on the wick and falling to the pump casting below before the travelling collector could return to intercept it.

Following these two observations, a dummy oiling system was rigged up on the crosshead of the stand-by unit in the station, and an effort made to determine the amount of loss sustained. Duplicating in all essential features the usual lubricator, this set carried a removable cylinder into which the oil intercepted by the collector was run, and in which could be measured the oil gathered that normally would be available for lubricating the pin bearing.

All determinations were made after the oiling system had been operating long enough to insure flow through the tubing and saturation of the wicking. Results were obtained by weighing oil in the lubricator at the time each test was started, and the amount lost determined by subtracting the weight of oil caught from that fed through the lubricator.

Starting first with the speeds normally found in pump operation, a number of tests were run and discarded as being too high in loss to be considered possible. On the test at 45 strokes per minute, with the lubricator set three in. from the inner end of the 24-in. stroke of the crosshead, the weighings consistently indicated that one-fifth of the oil fed through the cup was wasted. These values, at first discarded as being too high, were rechecked later and considered correct in the light of subsequent tests at other speeds.

As the pump used was motor-driven through a variable speed gear (employed normally for maintaining maximum line capacity at maximum allowable pressure in connection with other pumps running at standard speed) a minimum of three eight-hour determinations of oil loss was made for each increase of five strokes per minute from an initial run at that figure.

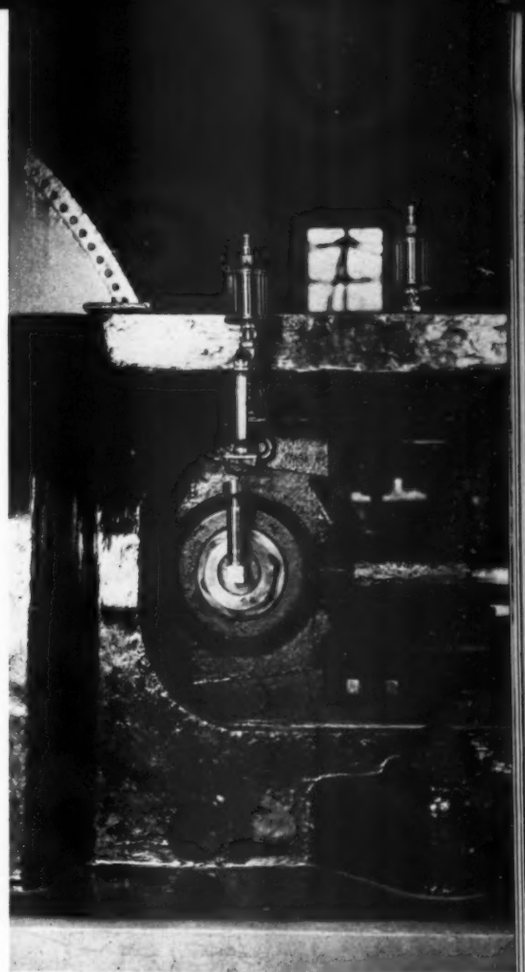
Where the results from the three runs checked closely, they were accepted as approximately correct, but in the figures quoted for pump operation at from 30 to 50 strokes at least eight checks were made before the findings were accepted as correct.

To determine the variation in loss as the point of contact between wick and collector scraper was moved inward from the end of the crosshead travel, tests were run with the feed set at 2, 3, 4, and 12 in. from the end —the latter being midway of the crosshead travel.

TABLE I

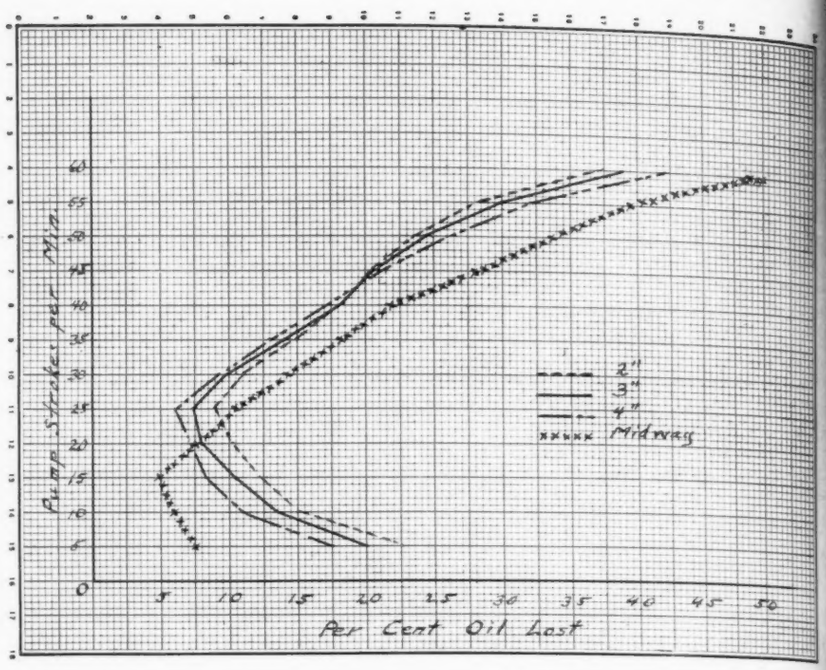
Percent of Oil Lost

Pump Strokes Per Minute	Lubricator Position (from end of stroke) 2 in.	3 in.	4 in.	Mid.
5	22.5	20.0	17.5	7.5
10	15.0	14.0	11.0	6.1
15	12.1	10.5	8.4	4.9
20	10.2	8.0	7.6	8.1
25	9.0	7.4	5.9	10.5
30	11.0	9.8	9.3	14.3
35	14.9	14.0	12.9	18.2
40	18.3	18.4	17.0	21.8
45	20.4	20.6	20.8	28.0
50	23.6	24.2	25.9	33.6
55	28.3	29.7	30.1	39.3
60	37.4	38.8	42.3	48.9



Type of lubricator checked for spatter and non-interception loss on pump with 24-in. plunger stroke

Curves showing percentage of oil lost at various pump speeds



As the tabulated results and curves show, oil loss reaches a minimum at a speed at which the loss by non-interception is reduced by more frequent passes of the collector below the wick, and when the speed of the scraper, and consequent spattering action on the oil drop, has not yet reached maximum.

That most of the loss at slow speeds is due to the dropping of oil from the wick is apparent, as the accompanying curves show. It is seen that the midway position of the wick allows the collector to catch the oil twice for each stroke at approximately equal intervals, while at the normal positions of such lubricators two contacts are made in quick succession, after which the collector must travel to the outer end of the stroke and return almost another 24 in. before again contacting the wick. At higher speeds, however, the velocity of the collector increases rapidly as the point of contact is moved outwardly from either end, and the spattering of the oil thus aggravated. Thus, at 60 strokes per minute almost half of the oil fed is wasted.

None of the tests was protected against loss by wind blowing oil droplets at the instant of impact of the scraper, thus duplicating normal operating conditions. It is considered that results given are conservative, rather than exceeding actual delivery of oil to the crosshead pin bearing while running, due to the care exercised in attaining most advantageous contact of scraper with oil drop on wicking, and possibly also to the fact that the dummy or testing set was mounted within the pump frame, instead of outside it, as are lubricating fittings normally.

Evaluation of oil lost or wasted by the type of lubricator used, computed on the normal operating speed of the pumps, showed that the wastage amounted to 0.309 pints of oil per crosshead each 24-hour day, or 9.27 quarts of oil per pump each month.

As a result of the survey the wick and scraper types of lubricating systems have been removed in favor of the telescoping tubing type, the saving in oil bills being applied against the initial cost of the change.

Netherland India Ranks High in Crude Oil Production

NETHERLAND India ranks among the foremost oil-producing countries of the world. Since 1893 these islands have produced 678,195,000 bbl. of crude petroleum from basins of Tertiary rocks between uplifted older rocks, as in Sumatra and Borneo, or from moderately uplifted Tertiary beds, as in Java, Madoera, and Ceram. Future production may be sought in Netherland New Guinea in the downfaulted basins of Tertiary strata on both sides of the Central Range. Although seepages occur in the Tertiary beds of central Celebes and in the Triassic beds of southwestern Timor, both the Mesozoic and the Tertiary of these islands are believed to be too highly folded and faulted to promise large accumulations of oil or gas.

Expansion of oil production in Netherland India has been greatest in the last 11 years. From 21,422,000 bbl. in 1925, the total output increased to 47,172,000 bbl. in 1935. Increased production in Sumatra, especially in the Residency of Palembang, has more than offset declines in the output of crude in Borneo and in Java and Madoera.

The development of petroleum in Netherland India has been connected closely with the history of the Royal Dutch Company for the Working of Petroleum Wells in Netherland India. This company, founded June 16, 1890, was merged in 1907 with the Shell Transport and Trading Company of London, thereby gaining shipping, storage, and marketing facilities. By 1911 it had absorbed most of the producing companies in Netherland India. In 1920 the Bataafsche Petroleum Maatschappij, an operating subsidiary of the Royal Dutch-Shell group, founded in 1907, produced 16,400,000 bbl. or 97 percent of the total oil output of Netherland India. A small production in Palembang and in Java was owned by the Nederlandsche Koloniale Petroleum Mij., a subsidiary of the Standard Oil Company of New Jersey, founded in 1912, and by small local independent companies.

Interest was directed in 1920 to the undeveloped Djambi field, in east-central Sumatra, where seepages and general geology indicated the presence of petroleum. On November 20, 1920, a bill was introduced in the States-General at The Hague to establish a new corporation, the Nederlandsch-Indische Aardolie Mij., for the exclusive development of the Djambi oil field by nationals only. In spite of protests made to the Netherland Government against the exclusion of American capital from the development of Djambi, the States-General approved the bill in the spring of 1921, and on December 4, 1921, the Nederlandsch-Indische Aardolie Mij. was constituted. Of its capital of f. 10,000,000, the Government of Netherland India subscribed half, and the Bataafsche Petroleum Mij. one-half.

In subsequent years, however, the Koloniale succeeded in obtaining concessions to other fields in Netherland India. Its production of crude petroleum increased from 80,000 bbl. in 1925 to 13,970,000 bbl. in 1935, and its share in the total production from 0.33 percent in 1925 to 29.8 percent in 1935. Its principal production is obtained from the Talang Akar and Pendopo fields, in southern Sumatra.

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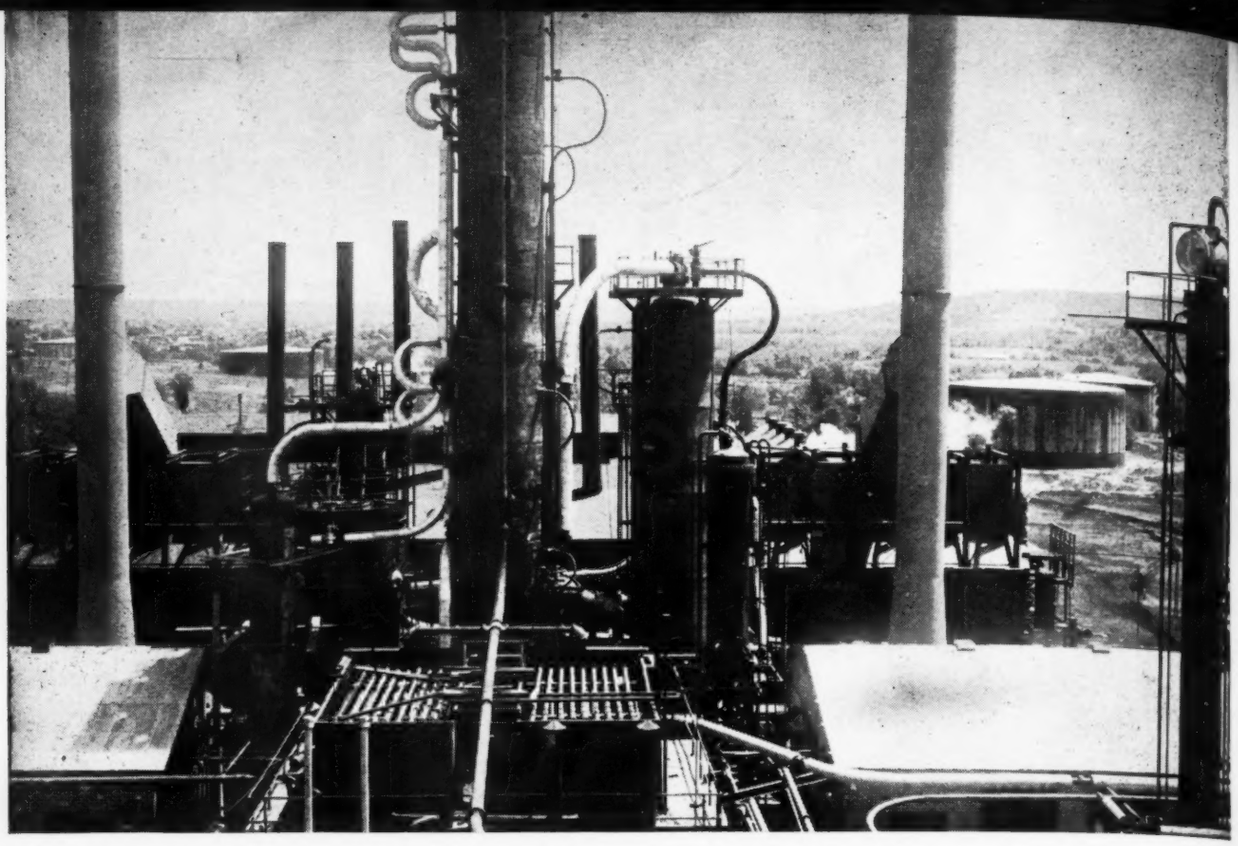

New unit with pump houses and condensers in the foreground and furnaces in the background, the stabilization tower to the right, and fractionating column and flash chamber in center

Design and Operation of Johnson Oil Refining Company's New Cracking Plant

Two-coil selective cracking unit, with stabilization and absorption equipment, has capacity of 2500 bbl. a day

By WM. J. LEENHOUTS

Refinery Superintendent, Johnson Oil Refining Company

THE Johnson Oil Refining Company has just put into operation a new Dubbs cracking plant at its Cleveland, Oklahoma, refinery and now has one of the most up-to-date units in the Mid-Continent area.

Rapid strides have been made in the last few years in the design of cracking plant equipment and the new unit bears very little resemblance to units of similar type erected five or ten years ago, when design and efficiency are considered.

The problem most annoying with the former type of units has been one of keeping them on stream for any great length of time.

As the Johnson Oil Refining Company designed its plant for long cycles of operation ranging from 30 to 60 days, numerous setups for cracking were considered before the present new unit was determined upon.

It has been known for some time that all charging stocks cannot be cracked under the same conditions of time and temperature. Some oils, even in the same process, require relatively low temperature with short time while others may require high temperature with long soaking time. There is, therefore, a preferred design and arrangement for each type of cracking process. Greater yields of high-octane and better quality gasoline are being obtained by selectively cracking topped crude and other stocks.

Selective cracking units are designed economically with two or more cracking furnaces and a combined secondary system in which the light and heavy fractions of fresh feed and recycled stock are segregated for charging into separate coils.

Johnson Oil Refining Company's unit is a two-coil selective cracking unit with stabilization and absorption equipment, having a capacity of 2500 bbl. a stream day.

In order best to explain the design of the new cracking unit it will be of value to follow the flow of the oil through the plant.

Part of the topped crude is used as an absorption medium before entering the cracking plant proper. Topped crude is pumped over the top of the absorption tower, going down the tower counter-current to the gases coming up. All gases made on the new unit are passed through this absorption column. The dry residue gas leaves the top of the absorption column ready for use as a refinery fuel. The furnaces are heated by the gases made in the process of cracking. The gas-saturated topped crude, together with the remaining topped crude, is then pumped into the main fractionating column.

See THE GREAT TIME SAVER in use!

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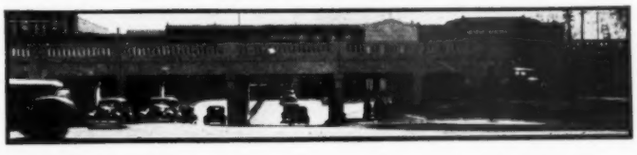
(Right, Center)
Cementing oil well in West Texas

(Above) *East End School, Houston, Texas*

(Below) *Grade separation, Abilene, Texas*



(Below) *Cementing oil well in Rodessa field*

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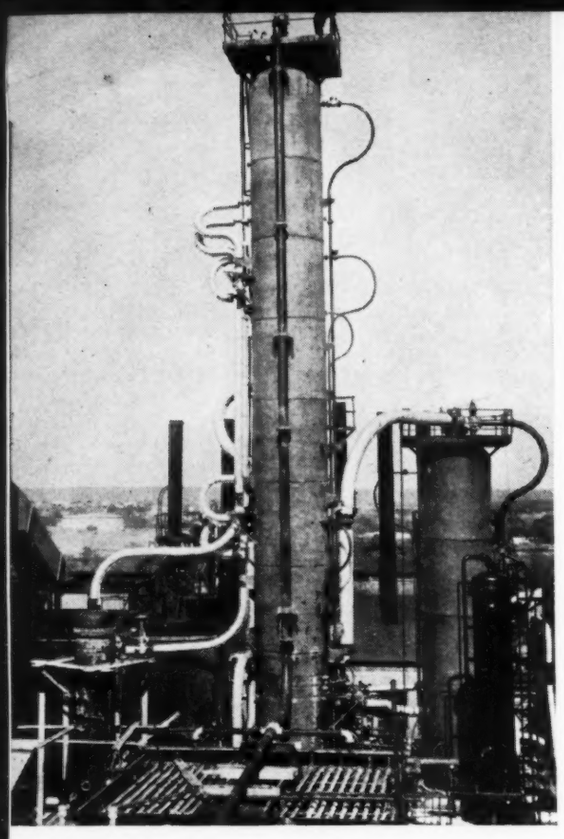


Main fractionating column and flash chamber

The main fractionating column is a vessel 7 ft. in dia. by 73 ft. in height. The tower has a working pressure of 95 lb. and an operating pressure of 75 lb. with a temperature range from 350 to approximately 800 deg. fahrenheit. The tower contains 26 trays, the top section being filled with bubble trays and the lower section with side to side trays. Several streams are removed from the fractionating column.

At this time we shall follow only the two charging stock streams that are taken off the bubble tower. The topped crude is pumped onto the 17th tray of the tower and flows downward and counter-current to the hot cracked vapors from the unit. These hot vapors going up the tower segregate and fractionate the recycled stock and the topped crude into two distinct cracking fractions, one a heavy oil fraction of approximately 18 to 19 gravity, which is taken from the bottom of the fractionating tower; the other fraction is taken off the reservoir at the 12th tray of the fractionating tower and is a light oil cracking stock of approximately 24 to 26 gravity. This charging stock has a boiling range between 400 and 600 deg. fahrenheit.

Before describing the fractionating tower further, and the products it takes off, the two types of cracking stock and their flow through the hot-oil pumps and the furnaces will be discussed.

The heavy-oil cracking stock is picked up by a 5¾-in. by 18-in. Worthington horizontal-duplex, outside endpacked, plunger pump, driven by a Worthington 3-cylinder, 4-cycle vertical Diesel engine. The capacity of this pump is 256 to 360 gal. per min. at a temperature of 685 to 750 deg. fahrenheit. The pump is capable of working at a discharge pressure of 700 lb. and has a suction pressure of 70 pounds. It has water-cooled glands, plunger, and pedestal, and the liquid end is of forged steel.

The light hot-oil pump is similar in construction to the heavy-oil pump, except that it has a 4½-in. bore and an 18-in. stroke. It has a capacity of 138 to 187 gal. per min. at a temperature of 570 to 630 deg. fahr., and is capable of giving a discharge pressure of 950 lb. with a suction pressure of 70 pounds.

The course of the oil from the hot-oil pump to the heavy-oil furnace is as follows:

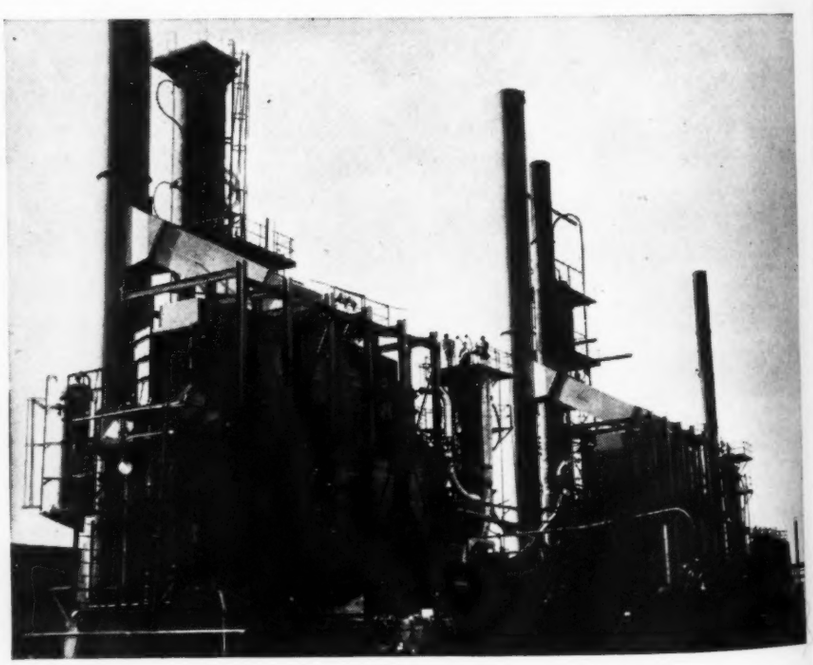
The furnace is a center wall, updraft, radiant type furnace, having a fire-wall that extends through the full length of the furnace, dividing the interior into two compartments. The side wall and roof are of refractory tile construction and all the tile are suspended and held in place by hangers bolted to the structural steel work of the furnace.

The refractory tile is backed with a 2-in. insulation, an air space, and then ⅛-in. steel flashing. Passage of oil through the furnace is in two parallel flows, one in each compartment. The furnace is capable of handling 6500 bbl. of new charge and recycled stock each stream day. The inlet pressure is approximately 500 lb. at a temperature of 685 deg. fahrenheit. The outlet pressure is approximately 250 lb. at a temperature of approximately 935 deg. fahrenheit.

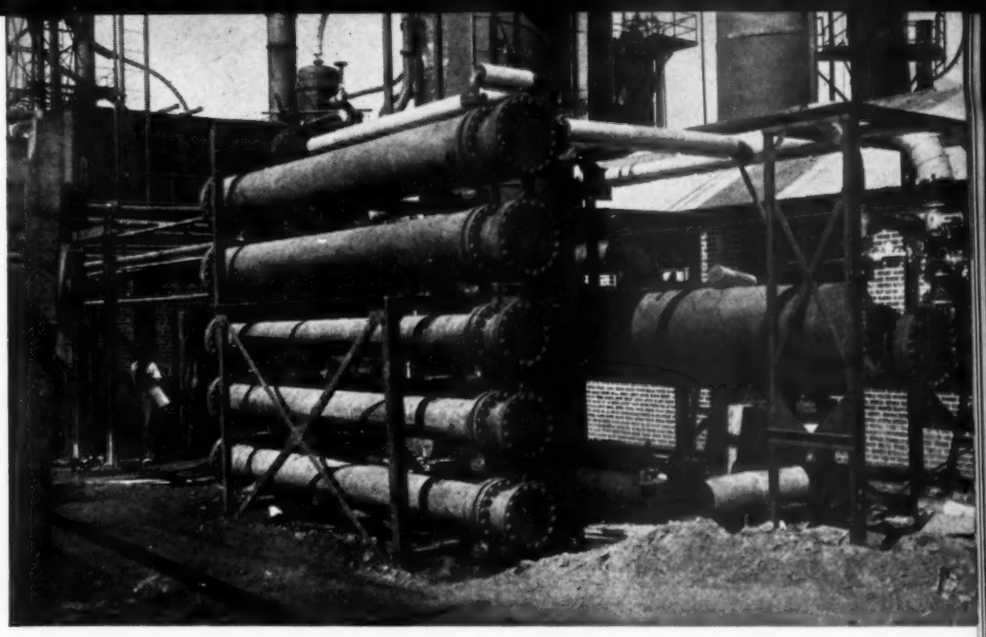
The charge to the furnace is divided into two equal parallel streams through each half of the furnace. Each stream passes downward through the convection section, which consists of 52 tubes of 3¼-in. O.D. and 2½-in. I.D., then through the radiant shock tubes of the roof of the furnace, of which there are 12 in number of 2¾-in. O.D. and 2¼-in. I.D., then through the radiant wall tubes, 36 in number, with 2¾-in. O.D. and 2¼-in. I.D.

The furnace is fired by 20 gas burners set in the floor of the furnace close to the centerwall. The gases go upward at such an angle that the flames impinge on the projected fire brick, which are set in a staggered fashion in the center wall. The course of the gases is upward along the centerwall through the roof tubes and through the convection sections into the breeching of the stack.

The furnace is a radiant-type heater. By this is meant that 70 to 75 percent of the heat is absorbed in the radiant section of the furnace. In the company's former furnaces, heat was absorbed almost entirely in the convection section. In this radiant-type furnace heating must be so arranged that the tubes are out of the path of the hot or burning gases. Flame impingment on tubes will cause overheating



An oblique view of the front of the two furnaces



Closeup of the stabilization equipment showing reboiler, after-cooler, and heat exchangers

of the tubes with resultant coking and loss of tubes.

In the new-type furnace combustion in the radiant section takes place without flame impingment. The direction and velocity of the flue gases are controlled and uneven heating is eliminated. For best results and long runs when cracking heavy oil the time element under high temperature should be reduced to a minimum and the oil brought quickly and uniformly to a maximum desired temperature at the outlet of the furnace.

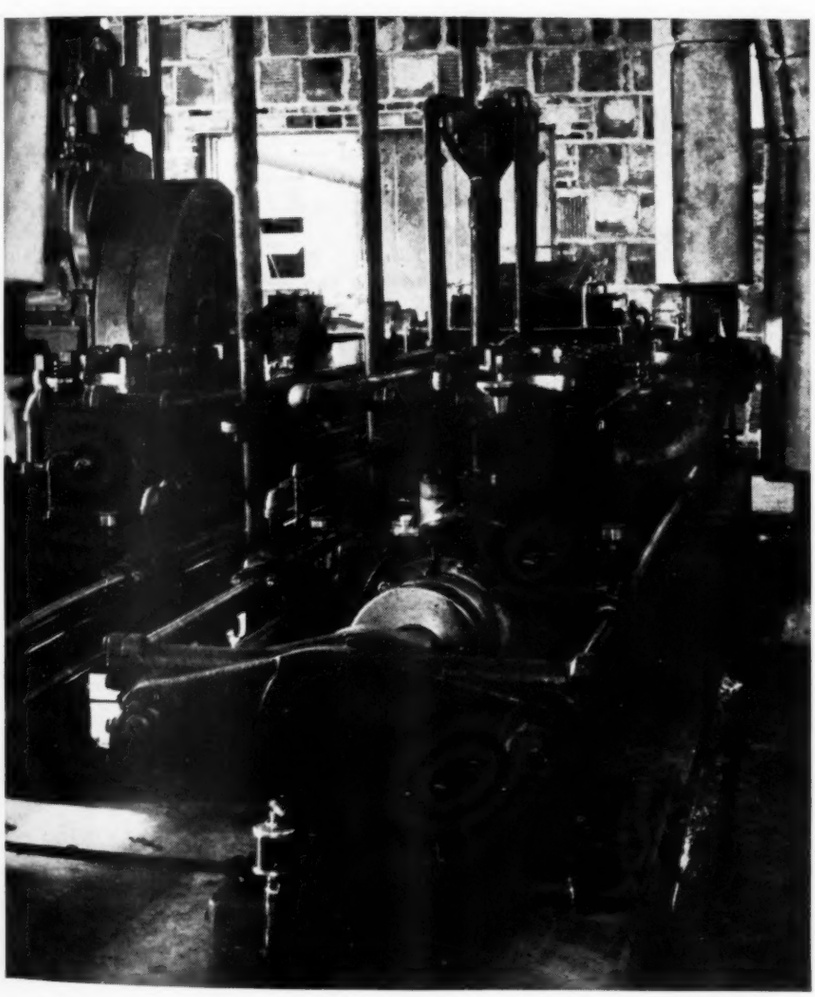
Passage of the oil through the tubes at high velocity is accomplished by the Worthington hot-oil pump. The heavy hot-oil pump allows a pressure drop through the furnace of more than 250 pounds. This pressure drop results in a very rapid passage of the oil through the tubes.

Although the design of the light-oil furnace is similar to the heavy-oil furnace, the flow of the oil through the furnace is slightly different. The charge is pumped through the convection section of the heater in two equal parallel streams. These streams are then combined at the outlet of the convection section and flow in series through the left side or radiant section of the furnace, from the bottom upward, then across through the radiant roof section tubes, and down the right side wall tubes that make the soaking bank of the furnace. As the left side of the furnace contains soaking bank, it can be fired separately and the temperature can be controlled independently.

The light-oil furnace is capable of handling 3500 bbl. of light recycled stock each stream day. The inlet pressure to the furnace is approximately 900 lb. and the oil has a temperature of about 570 deg. fahrenheit. The outlet pressure of the furnace is 600 lb. per sq. in. and the temperature approximately 985 to 995 deg. fahrenheit.

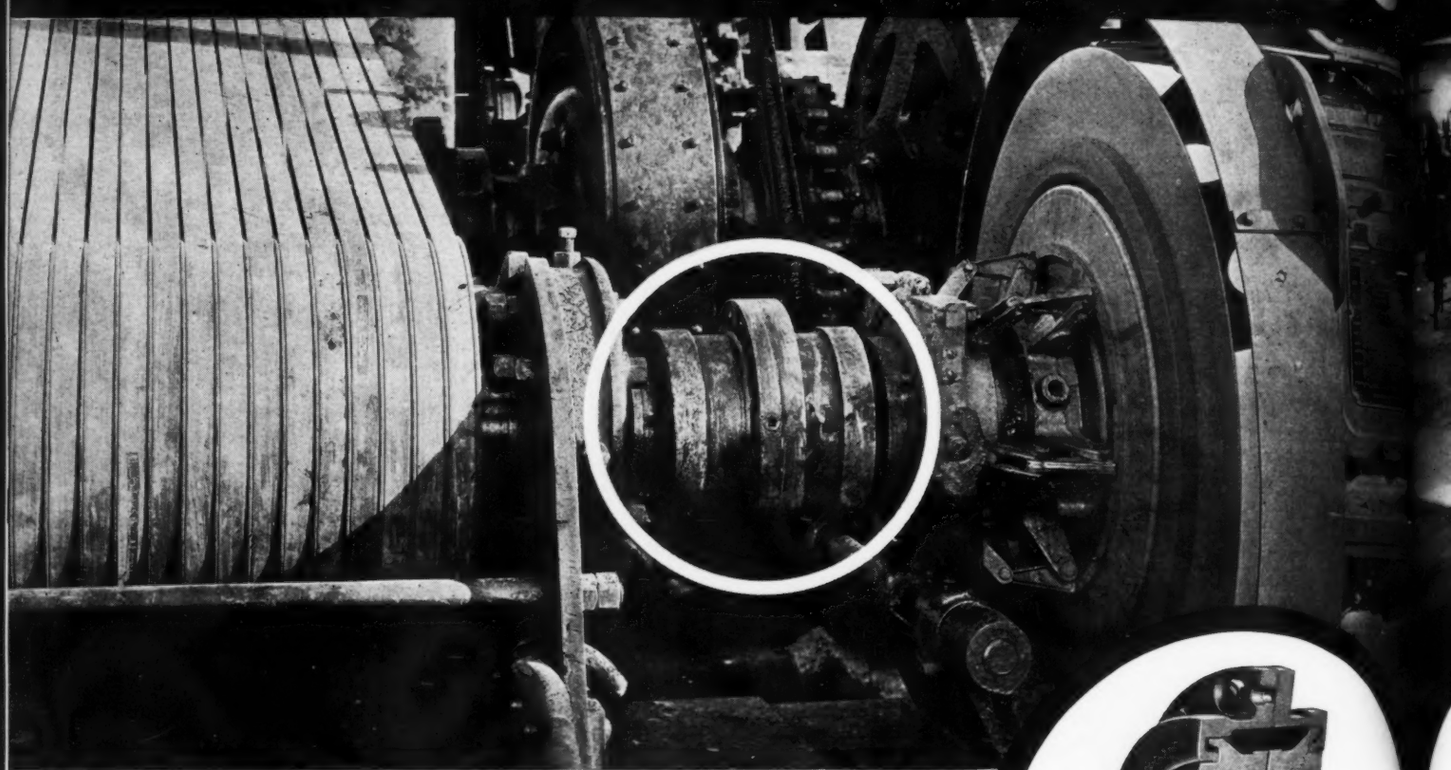
This two-coil, two-furnace hookup permits the operator to bring each type of charging stock to the most desirable temperature and conditions for cracking. If the light- and heavy-oil charging stocks were circulated through a single furnace coil until they reached a temperature of 990 to 995 deg. fahr., the heavy oil would coke in the tubes, causing a shutdown, or if heated only to 930 to 935 deg., the light oil would recycle several times without much cracking. This illustrates the distinct advantage of selective cracking.

The streams from the light- and heavy-oil furnaces, which run 995 and 935 deg. fahr., respectively, are combined into common transfers before entering the reaction chambers. The two reaction chambers both are 3 ft. 6 in. in diameter and 25 ft. long. One has a wall thickness of 2½ in. and a working pressure of 530 lb., and the other has 1¼-in. wall thickness and 260-lb. working pressure. The reaction chambers cause the cracking stock to remain at a high temperature for a longer period of time. The cracked stock goes into the top and out the



Interior view of the pump house showing hot-oil pump with Diesel engine to the left

FAST'S COUPLINGS



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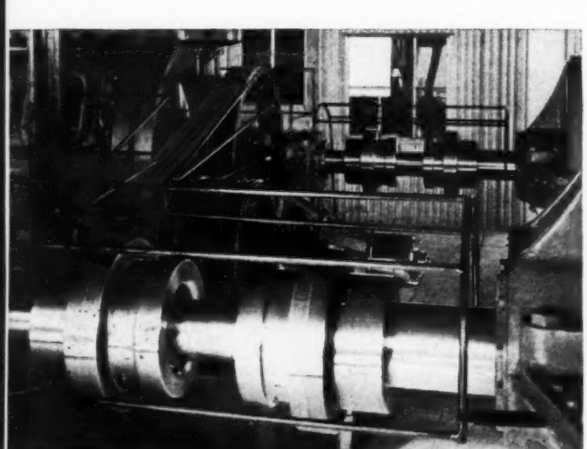
THE "INSIDE STORY" OF FAST'S SUPERIORITY



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Here Fast's Couplings are in operation in a pipe line station of the Skelly Oil Co. Fast's will be found in every division of the oil industry from production to refining.

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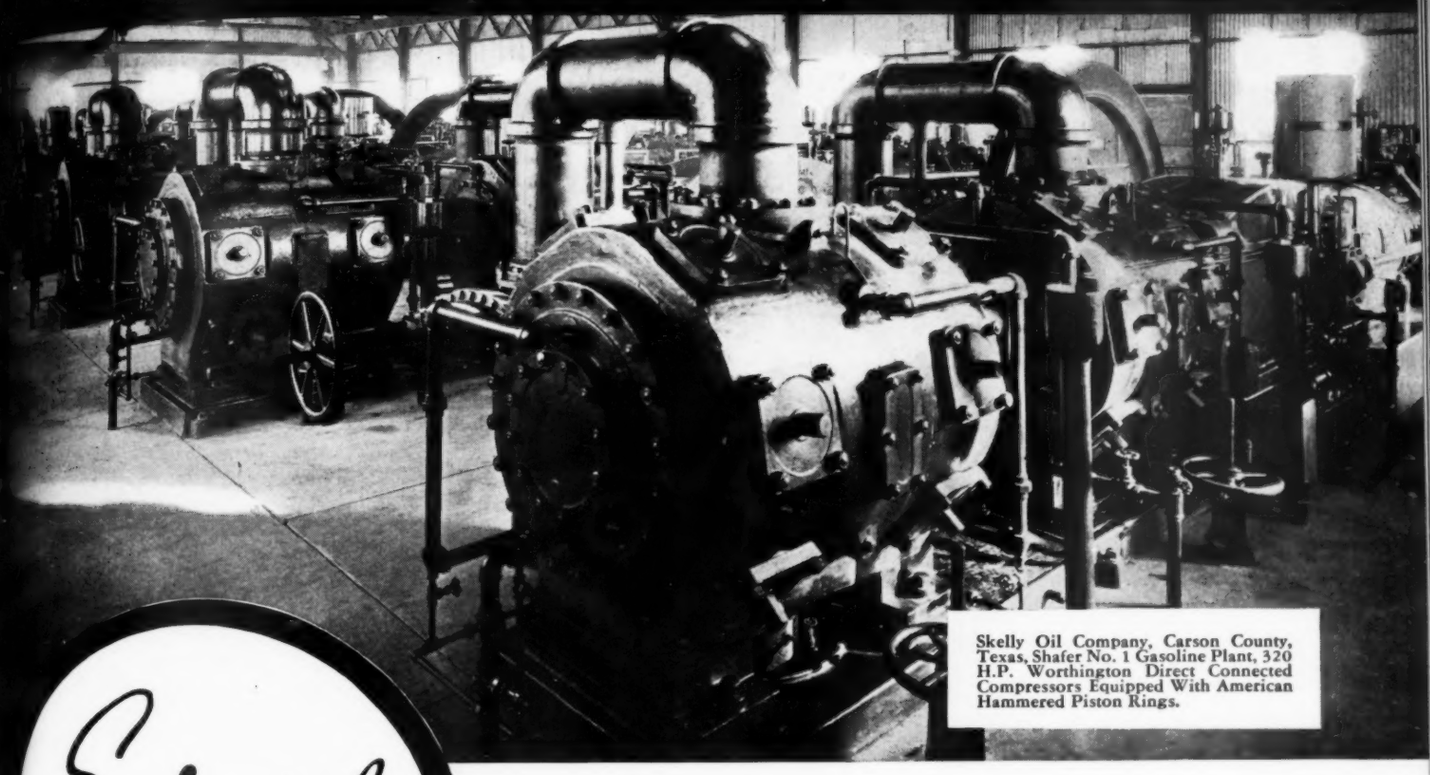

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And THAT for steam and other relatively heavy duty machinery, you should use an alloy of the grain structure shown?

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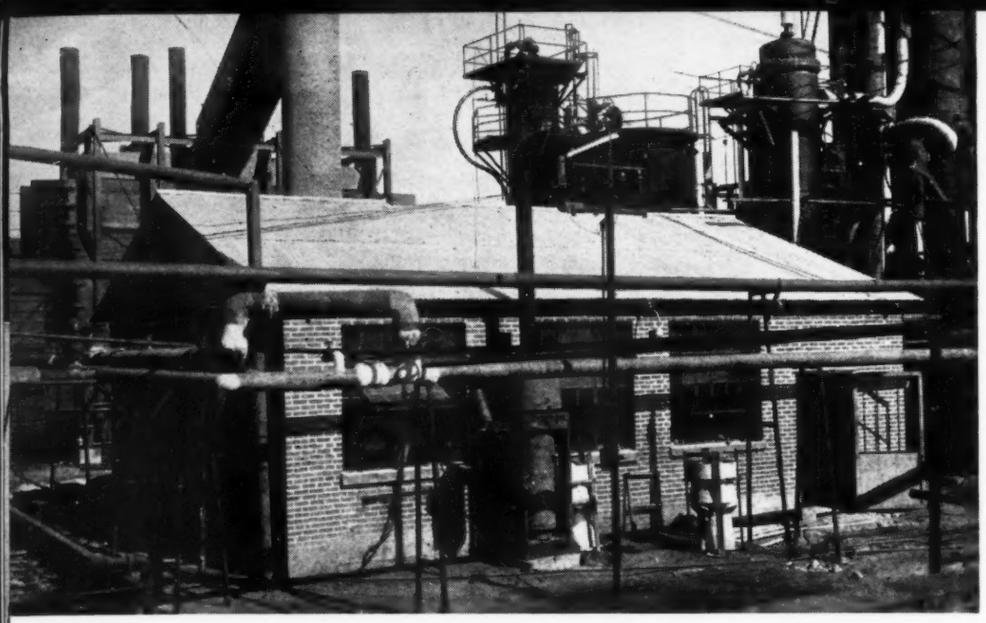


Closeup of one of the pump houses

bottom of the reaction chamber. After this material leaves the reaction chamber the pressure drops to 75 lb. and enters the flash chamber.

The flash chamber is 7 ft. 6 in. in diameter by 32 ft. 6 in. in length, of 1-in. thickness, and has a working pressure of 95 lb. at a temperature of 850 deg. fahrenheit. In the flash chamber occurs a separation of the cracked vapors and the residual fuel oil. The vaporized fractions pass out the top of them chamber to the main fractionating column and the heavy residuum flows from the small pot in the base to a 10 by 5 by 12 hot-oil pump, which, in turn, pumps it through the residuum cooler, and thence to the storage tank.

The fluid level in the flash chamber is held constant by a float control in the bottom of the flash chamber and only a small quantity of oil remains in the chamber at one time. The fuel oil from the plant is a residuum of Bunker C specifications. This fuel can be cut back with a fraction taken from the main bubble tower, thus making a lighter grade of fuel oil.

To return to the main fractionating tower, where we originally began with the topped crude. The topped crude originally was pumped onto the 17th tray of the fractionating tower and the cracked hot vapors discharged into the bottom of the fractionating tower. These vapors pass upward through the fractionating tower and as they do so are fractionated into various types of distillates, fuels, and charging stocks.

Several streams can be taken off the main fractionating tower. First of all, a stream of unstabilized endpoint gasoline is taken off overboard. The temperature in the top of the tower and the endpoint of the gasoline are controlled by means of a reflux pump that discharges cold pressure distillate over the top of the tower, thus controlling the temperature of the vapors leaving. The plant can be operated so as to make only endpoint gasoline, residuum fuel, and gas, but it also is possible to take off various side-cuts as the market may demand.

From the seventh tray of the fractionating tower it is possible to take off a side cut of tractor distillate. This material is finished in a side-stripper column that is of 42-in. dia. and 22 ft. long. This same side-stripper column can be used in making No. 1 or No. 2 furnace oil by taking a side-cut from the 9th bubble tray of the main fractionating column.

It is possible also to take off a fraction from the 12th or 16th bubble trays. This fraction can be used for fuel purposes or for a cut-back to decrease the viscosity of the residuum fuel.

In addition to the fractions mentioned, the tower also fractionates the charging stock to the furnaces into two distinct fractions, one being a heavy high-boiling charging stock that is taken off the bottom of the bubble tower, the other a light clean distillate charging stock taken from the 12th tray of the bubble tower.

After the unstabilized vapors leave the bubble tower they pass through the conventional-type condenser coils and into a reflux distillate accumulator. From there the unstabilized gasoline passes through the subcooler countercurrent to water at 60 deg. fahr., and then into the distillate receiver. The unstabilized gasoline is then picked up by a 12 by 5 by 12 Worthington duplex pump that boosts it into the stabilization system. The stabilization system contains a stabilizer column equipped with two charge-to-bottoms heat exchangers, shell-to-tube reboiler at bottom of tower and shell-to-tube condenser on top, and three shell-to-tube, water-to-gasoline after-coolers. After leaving the pump the gasoline passes through a heat exchanger countercurrent to the stabilized gasoline as it is leaving the plant. After passing through the heat exchanger it is discharged into about the middle of the stabilizing column.

The stabilizing column, of 42-in. diameter and 43 ft. high, contains 26 bubble trays and has three nozzles through which the feed may enter the column. The temperature at the base of the stabilization column is maintained by a shell-to-tube reboiler through which the gasoline passes countercurrent to a fraction of hot oil from the bubble tower. This hot oil maintains a temperature in the reboiler of approximately 320 deg. fahr. and 280 deg. fahr. in the bottom of the stabilization tower. The temperature in the top of the column is controlled by a water condenser and can be held at a temperature so that gasoline of any desired vapor pressure can be made. The unstabilized gasoline enters the middle of the stabilizer tower, getting warmer and warmer as it goes downward to the bottom, and then to the shell-to-tube reboiler where it reaches a temperature sufficient to drive off all undesirable light hydrocarbons. The stabilized gasoline then passes out through two heat exchangers countercurrent to the incoming gasoline and on through three sections of a water-to-gasoline aftercooler, the gasoline flowing countercurrent to water coming into the plant at a temperature of 60 deg. fahrenheit. From there the stabilized gasoline goes to the storage tank. After passing through the stabilization system the gasoline is free of ethane and propane and the butane percent is controlled according to the vapor pressure of the gasoline desired.

The gas vapors leaving the top of the stabilizing tower may still contain desirable gasoline fractions and they in turn are passed back through the absorption column where the desirable gasoline constituents are picked up. The stabilization system is capable of processing 65,000 gal. of gasoline daily.

Gasoline of any desired vapor pressure and distillation range can be made. Endpoint also can be varied to meet seasonal demands. The yield of gasoline can be varied between 50 to 60 percent, according to the distillation range and octane desired. In making the usual 400-endpoint gasoline of 68/70 octane, yields of at least 55 percent can be obtained.

The new unit has all the latest control instruments. Flow controllers,

JOHNSON OIL REFINING COMPANY
Cleveland, Oklahoma

Typical Analysis of Some of the Products Made on New Unit

	Gasoline from Dubbs Unit		Oil to Light Oil Furnace		Charging Stock to Dubbs Unit	Analysis of Residuum Fuel
Gravity	59.4	59.3	24.5	24.4	27.0	Gravity—9.5 Be.
Reed Vapor Pressure	9.6 lb.	9.8 lb.				Flash—275°F.
Octane Number	68	68				Fire—375°F.
Initial Boiling Point	95°F.	95°F.	400°F.	400°F.	535°F.	Furol Vis at 122—120 sec.
Percent						Pour Point—Below 25°F.
10	132	136	460	455	569	B. S. & W.—0.4%
20	163	170	471	469	611	
30	197	205	482	480	642	
40	225	236	489	487	675	
50	253	266	495	496	692	
60	279	292	507	507	716	
70	305	314	522	520	743	
80	333	340	539	536	750	
90	368	368	556	557	764	
95	386	388	575	572		
End Point	397	396	604	599	784	
Recovery	97.0%	96.5%	98.0%	98.0%	94.5%	

liquid level controllers, pressure controllers, and pressure-recording and temperature-indicating and recording instruments are used on the unit and are set in the center of the instrument board in the control house. This instrumentation allows a close correlation of the various parts of the unit and tends toward longer runs, smoothnes sof operation, and better products.

Johnson Oil Refining Company has a plant and eqpipment that has flexibility of operation so that various types of products can be made, and so that operating conditions can be varied to meet changing requirements.

It is operated under the Dubbs patents and the engineering was done under the supervision of the Universal Oil Products Company. The construction work was by the Johnson Oil Refining Company personnel, except the furnaces, which were built under contract by the Frick-Reid Supply Corporation. The stabilization equipment and the main fractionating tower were built by Tulsa Boiler and Machinery Company. The hot-oil pump and Diesel engines were built by the Worthington Pump and Machinery Company. The instruinstruments were manufactured by Leeds and Northrup and the Taylor Instrument Companies.

Petroleum Refining in Japan

THE manufacture of refined oils in Japan both from domestic and imported crude oils has grown from a total output of 2,803,000 bbl. in 1925 to 8,715,000 bbl. in 1935. Nevertheless the refineries of Japan met only 57.2 percent of the total demand in 1925 and 34.1 percent in 1935. They supplied in 1935 all the gas oil, solar oil, and neutral oil apparently consumed in Japan, 50 percent of the gasoline, 50 percent of the kerosene, 94 percent of the lubricating oil, and 12.5 percent of the fuel oil.

In 1925 Japan had 11 refineries, with a total capacity of approximately 12,000 bbl. daily. Eight of these were classed as "old"; only three were equipped with cracking plants. All were owned by Japanese companies. In 1936 the Ministry of Commerce and Industry listed 77 refineries, including gasoline plants, of which 36 were in the Niigata Prefecture, nine in the Prefecture of Akita, and eight in the Prefecture of Kanagawa. Thirteen of the larger refineries at the end of 1935 had a capacity of 28,800 bbl. daily, while seven cracking plants had an additional capacity of 8000 bbl. a day.

Despite all efforts to foster a domestic petroleum refining industry, Japan still depends on imports for its supply of refined products. Demand has grown faster than the extension of refining facilities. In 1925, 47 percent of the refined oils were imported; in 1929, 71 percent; and 1935, 67 percent.

By far the greater part of the Japanese imports of mineral oils has consisted of crude petroleum and fuel oil. Japanese import statistics, by countries of origin, do not distinguish between refinable crude petroleum and fuel oil for immediate consumption, but include them in a single category of "crude oil and heavy oil." In practice there is no sharp distinction. Certain heavy crudes from California, as well as Tarakan crude from Borneo, may be and are burned directly as fuel without refining. On the other hand, in a modern cracking plant fuel oil and crude oil of any gravity may be and are used as raw material for the manufacture of gasoline and other refined products.

Of the crude oil and heavy oil imported into Japan from 1930 to 1935, the United States supplies 62.6 percent, Netherland India 10.3 percent, and northern Sakhalin 11.4 percent.

Preliminary statistics for 1936 show imports into Japan of 24,609,000 bbl. of crude petroleum and fuel oil, 4,121,000 bbl. of gasoline, 473,000 bbl. of kerosene, and 398,000 bbl. of other oils, chiefly lubricating. Of the imports of crude petroleum and fuel oil, the United States supplied 18,107,000 bbl., Netherland India 5,205,000 bbl., British Borneo, 2,004,000 bbl., and Manchuria, 456,000 barrels.

Petroleum Refining in Netherland India

AT the end of 1935 the Bataafsche Petroleum Maatschappij, an operating subsidiary of the Royal Dutch-Shell group, had five refineries in operation in Netherland India, with a total capacity of 93,000 barrels. The largest at Balikpapan, in eastern Borneo, had a daily capacity of 35,000 barrels. In Sumatra it operated refineries at Pladjoe (27,000 bbl. daily) and at Pangkalan Brandan (15,000 bbl.) and in Java at Tjepoe (14,000 bbl.) and Wonokromo (2000 bbl.). The Nederlandsche Koloniale Petroleum Mij., a subsidiary of the Standard Oil Company of New Jersey, operated a refinery at Soengei-Gerong, Sumatra, with a daily capacity of 42,500 bbl. and a small refinery at Kapoean, Java, with a daily capacity of 500 barrels. A small refinery at Klantoeng, Java, belonging to the Algemeene Petroleum Mij. (independent), completed the list of active refineries.

Three-fourths of the crude petroleum produced in Netherland India is run to stills. The remainder, consisting of heavy crude produced on Tarakan Island and in the Boenjoe field, eastern Borneo, after a simple treatment to extract water and sand, is sold for fuel, especially for export to Japan, China, and Singapore. Gasoline, kerosene, fuel oil, and gas oil are the principal products manufactured in the refineries of Netherland India.

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Daughter of First Film Star: How do you like your new father?

Daughter of Second Film Star: Oh, he's very nice.

Daughter of First Film Star: Yes, isn't he? We had him last year.

The difference between a girl's boy friend and her parlor is this: When her boy friend is lit up he's full, but when her parlor is lit up it's empty.

"Do you mean to tell me," the judge said, "that you murdered that poor old woman for a paltry three dollars?"

"Well, judge, you know how it is. Three bucks here and three bucks there—it soon mounts up."

Little Audrey had a little baby, but she laughed and laughed and laughed, as she didn't care, because she knew that Italian Balm would take the little chap off her hands.

—*Penn Punch Bowl.*

We are told that in Arkansas the hill people have an ingenious method of weighing hogs. They place a board across a fence, stand the hog on one end, and pile stones on the other until it is balanced. Then they guess the weight of the stones.

The one-ring circus was visiting a town in the hills. The folks there recognized all the instruments of the band except the slide trombone. One old settler watched the player for quite some time, then said: "There's a trick to it; he ain't really swallerin' it."

—*Bridgeport Bulletin.*

My brother and I were twins. We looked so much alike that no one could tell us apart. One day in school my brother threw spitballs and I was punished. My brother was arrested for speeding and I spent three days in jail and paid a fine for it. I had a girl and my brother ran off with her. But last week I got even with him. I died and they buried *him!*

—*Annapolis Log.*

"Georgie, did you fall down in your good pants?"

"Yes, ma, I didn't have time to take 'em off!"

"What fo' yo' name yo' baby electricity, Mose?"

"Well, mah name am Mose, mah wife's name am Dinah, and if Dinamose doan' make electricity, what does they make?"

"What did the cute little French girl say when you asked her if she kissed and petted?"

"Adieu."

"You lucky stiff."

A new viewpoint: It isn't the girl that counts. It's what she stands for.

If every boy in the United States could read every girl's mind, the gasoline consumption would drop off 50 percent.—*Texas Battalion.*

He: You're Mae West, aren't you?

She: No. I'm June West, 30 days hotter than Mae.

Don't forget the Scotchman who called up his sweetheart to find out what night she was free.

"Lady, don't you know this is a safety zone?" said the officer on duty.

"Don't be silly! Of course I know; that's why I drove in here."

The decrepit car drove up to the toll bridge.

"Fifty cents," said the watchman.

"Sold," cried the driver.

"I insured my voice for $50,000," stated the famous singer.

"And what," asked his rival, "have you done with the money."

"What's the row over at the carnival?"

"Oh, a fake dentist sold the fire-eater a set of celluloid teeth."

It doesn't follow that a fellow is a good gymnast because he spends a lot of time chinning and hanging on the bar.

"We really must get a new car, John."

"What—when we're still paying installments on the car I exchanged for the car I sold in part payment for the car we've got now?"

TRIPLE ENTRY

Manager: I am inclined to give you the position if you understand the double-entry system of bookkeeping.

Applicant: I do, indeed! At my last place I had to do a triple entry—a set for the active partner, showing the real profits; a set for the sleeping partner, showing small profits; and a set for the income tax officials, showing no profits.

She (during a spat): Well, you can't say I ran after you, anyway.

He: No, I can't say that. The trap doesn't run after the mouse, you know, but it gathers it in just the same.

Stranger in Supply Store: Who's the close-mouthed fellow over there? He hasn't spoken a word in the last fifteen minutes.

Regular Loafer: Him? He ain't close-mouthed—he's jes waitin' for the storekeeper to bring back the spittoon.

Gospel Pipe Line

The colored preacher was talking to his congregation about free salvation. Finally he asked Brother Smith to take up the collection. At this point an old darkey got to his feet and said: "Parson, I thought you said salvation was free—free as the water we drink."

"Salvation is free, brother," replied the preacher. "It's free and water is free, but when we pipes it to you, you have to pay for the piping."

—*Pure Oil News.*

Mr. R. who was an habitual celebrant on all occasions, crept stealthily into his house one night, but despite his caution, fell and broke the empty bottle he was carrying in his hip pocket. He was sufficiently lucid to realize that first aid should be applied to the cuts which resulted, and accordingly backed up to the mirror and applied a generous dressing of adhesive tape. As Mrs. R. showed no signs of having been awakened, he was no little astonished when she roused him next morning with, "So you came home drunk again last night!"

"Why, my dear, what in the world gave you that idea?"

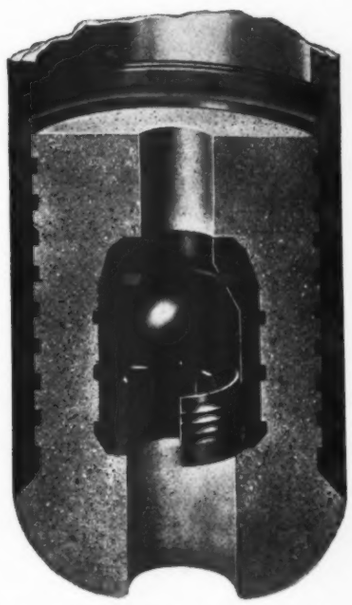
"Well, if you were sober," she countered, "will you please explain how the adhesive tape got all over the mirror."

See for Yourself

WHY AND HOW THE UNQUESTIONED SUPERIORITY OF DESIGN AND OPERATION OF THE BALL-TYPE VALVE USED EXCLUSIVELY IN BAKER CEMENT EQUIPMENT AFFORDS THE *ULTIMATE IN VALVE EFFICIENCY* . . .

HERE IS THE VALVE ASSEMBLY COMPLETE

Sectional view of Baker Cement Float Shoe showing the complete Bakelite Valve Assembly firmly anchored in Baker-Formula Concrete. Note how the Assembly is set on end to present a minimum cross section to the drilling bit.

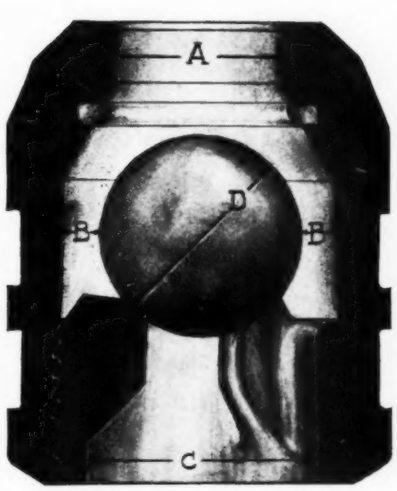


ONLY BAKELITE IS USED IN CONSTRUCTION OF VALVE ASSEMBLY

The Valve Seat, Cage and Ball of the Baker Valve Assembly are constructed entirely of Bakelite—a resin-like substance produced when carbolic acid is treated with formaldehyde and combined with powdered cellulose flour derived from wood or similar substance. This material is moulded under heat and pressure and then cured to the required hardness and friability. This friability provides the feature of being easily drilled up into small particles. Laboratory tests on the Bakelite Valve Seat, Cage and Ball have shown a strength far in excess of any pressure that might be encountered in the hole.

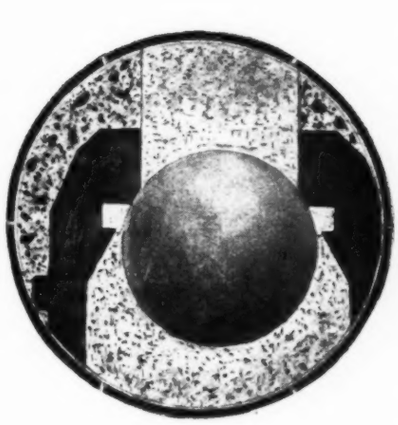
AMPLE CIRCULATION AREAS

As clearly shown in the accompanying illustration, Baker Bakelite Valve Assemblies are made with ample circulation areas to insure adequate and unrestricted passage of the cement. These areas, however, have been carefully designed to give the very desirable "wash-down" action that is so essential in many fields.



IMMEDIATE AND POSITIVE VALVE CLOSURE

The double-sealing action of the Baker Valve Assembly eliminates all possibility of leaking while floating in a string of casing and provides an immediate and positive valve closure following the cementing operation. Note how the ball fits tightly on its upper seat (a rubber ring backed by Bakelite) while the casing is being floated in. During cementing operations, it rests on projecting fingers around which the cement passes in an unrestricted flow through the passageways in the Bakelite Valve Seat.



BAKER BAKELITE VALVES OPERATE IMMEDIATELY AND POSITIVELY. THEY FURNISH A LEAK-PROOF SEAL AGAINST EITHER LOW OR HIGH PRESSURE WHEN FLOATING-IN AND STOP ANY CEMENT FROM BACKING UP INTO CASING WHEN PUMP PRESSURE IS RELIEVED.

. . . and in addition to valve efficiency, Baker gives you *STRENGTH and DRILLABILITY*

STRENGTH

It is stronger than the collapsing strength of the casing upon which it is run—safe for strings of any length.

DRILLABILITY

The plug and valve assembly being made of Bakelite and Baker-Formula Concrete permits both materials to be quickly and easily drilled out, drilled up and circulated out of the hole with the rotary mud. No dangerous metal is left to prevent coring directly below the shoe, or to deflect the bit and start an off-vertical hole.

It is BAKER Valve Efficiency combined with STRENGTH and DRILLABILITY that provide the perfectly balanced equipment for guiding, floating and cementing strings of casing.

Look on Pages 189 to 206 of the* BAKER CATALOG *or the* 1937 COMPOSITE CATALOG *for more complete details.

BAKER OIL TOOLS, INC.

Telephone JEfferson 8211 – HUNTINGTON PARK, CALIFORNIA – 2959 E. Slauson Ave.
Telephone WAyside 2108 – HOUSTON PLANT AND OFFICE – 6023 Navigation Blvd.

MID-CONTINENT OFFICE AND WAREHOUSE:
Telephone 2-8083 – Tulsa, Oklahoma – 312 East Fourth Street

WEST TEXAS BRANCH OFFICE
Odessa, Texas – Telephone 217

EXPORT SALES OFFICE
Rm. 1914 – 19 Rector St., New York City
Tel. Digby 4-5515

ROCKY MOUNTAIN HEADQUARTERS
Tel. 2230 – Casper, Wyoming – Box 1464

BAKER CEMENT EQUIPMENT

Running Tour
WITH MEN IN THE INDUSTRY

LEONARD WAMMOCK and **JOHN E. SEARLES,** drilling superintendents, who have been with the Shell Oil Company in California, are now connected with Sarawak Oilfields, Ltd., stationed at Miri, Sarawak.

F. W. FLOYD, in charge of production for the Carter Oil Company, recently was made a director of the company. He succeeds **GEORGE H. LANG,** who resigned to become an independent operator.

JOHN E. HOWELL, Bartlesville, Oklahoma, general production superintendent for the Empire Oil and Refining Company, has resigned to become vice-president in charge of production for the Lion Oil Refining Company, El Dorado, Arkansas. He succeeds **W. C. O'FERRELL** who resigned, effective July 1. **C. S. WARREN,** who has been superintendent of the Kansas division for Empire, takes over Howell's old post.

WALTER C. TEAGLE has resigned as president of the Standard Oil Company of New Jersey and been elected chairman of the board. **W. S. FARISH,** who has been chairman of the board, resigns that post to become president of the organization.

WALLACE E. PRATT, an executive of the Humble Oil and Refining Company, has been elected a director of the Standard Oil Company of New Jersey, filling a vacancy created by the death of **CHESTER O. SWAIN.**

C. E. NORDBLOOM, assistant drilling superintendent at Yenangyaung for the Burmah Oil Company, has been on leave at his home in Santa Barbara, California.

J. E. BAILEY, chief petroleum engineer of the Texas Railroad Commission, resigned June 1 to become associated with the Tide Water Associated Oil Company. His headquarters will be in Kilgore, Texas, and he will supervise petroleum engineering work in several fields in that area of the state. **C. M. LANGFORD** succeeds to the Railroad Commission post. He has been chief engineer of the Kilgore office of the commission.

J. P. MURRAY, Eldorado, Kansas, district superintendent of the Empire Oil and Refining Company, has been promoted to superintendent of operations for the Kansas division and will be in direct charge of all production operations in that area. **E. F. CANTRELL,** superintendent of the Madison and Greenwood counties, Kansas, district, succeeds Murray. **M. R. JOY,** assistant superintendent of the Seminole area, takes Cantrell's place. **W. W. O'NEILL,** in charge of North Texas operations, succeeds Joy. **EARL DOWSE,** superintendent of the Burbank, Oklahoma, district, takes O'Neill's place.

COXEY EVANS, superintendent of the Kansas fishing and drilling department of the Empire Oil and Refining Company, has been transferred to the Texas Panhandle as district superintendent under **M. M. MAHAFFEY,** division superintendent. **L. A. LINDSAY,** tool pusher, replaces him.

MAX PRAY has resigned as vice-president and general manager of the Sweet Oil Refining Company, Wyman, Michigan, to operate as an independent, although he will continue as a director of the company. **R. C. WILBUR,** who has been his assistant, becomes the new vice-president and general manager.

THOMAS B. SCOTT, executive assistant to the management of the Carter Oil Company, Tulsa, Oklahoma, has resigned. He will become an independent operator with headquarters in Tulsa.

FRED E. COCHRAN, who has been assistant material man in the Wewoka, Oklahoma, district for the Magnolia Petroleum Company is now affiliated with the Tropical Oil Company (Standard of New Jersey subsidiary) and is stationed in Colombia, South America.

J. J. FROMMER, division superintendent at Oklahoma City for the Ohio Oil Company, was transferred to Houston, Texas, on June 1, where he is general superintendent of production of the company's new Texas division.

E. W. BECK has been made manager of purchases of the General Petroleum Corporation, succeeding **ROBERT M. KETCHUM,** deceased. His headquarters will be Los Angeles, California.

F. T. NORRIS, who has been manager of the northern Alberta division of the Imperial Oil Company, making his headquarters at Edmonton, has been transferred to Calgary. He is now in charge of the company's southern Alberta division. He and **R. S. STEVENS** exchanged posts.

J. P. RUCKMAN, superintendent of the Hobbs, New Mexico, district for the Humble Oil and Refining Company, has been made superintendent in charge of the Hurdle, Big Lake, Yates, and Sand Hills districts. His headquarters will be at McCamey, Texas. He is succeeded at Hobbs by **H. S. McGARRY,** who has been in charge of the London, Texas, district. **L. C. PETERS,** superintendent of the Kilgore district, becomes superintendent of the London district.

LLOYD DOWNING has been made superintendent of the Midwest Drilling Company, a new concern. He will make his headquarters at Casper, Wyoming.

J. DONALD ROSS, who has been superintendent for the Ross Amigos Oil Company, at Mirando City, Texas, has accepted a position as petroleum engineer and geologist with Marsman and Company, and will be stationed at Manila, Philippine Islands.

G. H. HUSTEN, formerly division engineer of the Gulf Coast division of the Texas Railroad Commission, has resigned his post to take a position with an oil company in New Iberia, Louisiana.

ERIC FURNIVAL GRIFFIN, Sydney, New South Wales, Australia, succeeds **E. L. WALTER,** deceased, as managing director of Oil Search, Ltd.

J. S. WOODWARD, petroleum engineer, Magnolia Petroleum Company, has been transferred from South Texas to the Crane district of West Texas.

PROOF OF PROTECTION TO DRILL PIPE DURING ENTIRE LIFE

The photo shows drill pipe used in wells at Rodessa, in constant service more than a year. Note the original tool marks on the tool joint. That proves protection. Patterson-Ballagh Protectors prevent contact of tool joints against casing. The Protectors provide a resilient cushion which prevents abrasion, helps relieve friction and speeds up protection. Life of drill pipe is greatly increased. Thin casing is prevented. Ask for literature.

PATTERSON-BALLAGH CORPORATION

Plant and General Offices: 1900 East Sixty-fifth Street, Los Angeles, Calif., U. S. A.

New York Office: 39 Cortlandt Street Oklahoma Office: Oklahoma City, 1704 N. W. 17th Street

Texas Office: Houston, 1507 Maury Street Louisiana Office: Box 23, Oil City, La.

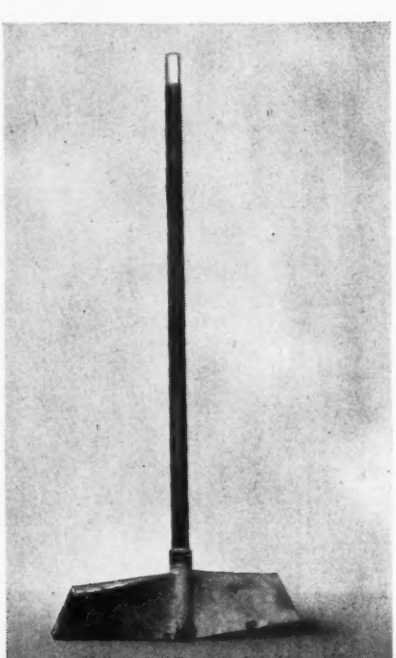
PATTERSON-BALLAGH DRILL PIPE & CASING PROTECTORS

MACHINERY and EQUIPMENT

New Alloy Resists Acids

A NEW alloy known as "Hastelloy B" is now being offered for use under extremely severe conditions of corrosion. The new alloy has been developed by two units of Union Carbide and Carbon Corporation working in collaboration—Haynes Stellite Company and Union Carbide and Carbon Research Laboratories, Inc. Hastelloy B is a further addition to the series of Hastelloy alloys originally developed eight years ago, and, like the others, is being marketed by Haynes Stellite Company, Kokomo, Indiana.

This new alloy has been produced primarily for service in equipment handling hydrochloric acid in all concentrations and at temperatures up to



Typical of the forms in which the new alloy, Hastelloy B, can be supplied is this paddle for agitating hydrochloric acid and aluminum chloride solution. The blade is formed from wrought plate and welded to a rolled shaft.

and including the boiling point. It also stands up well in sulphuric and phosphoric acids, acetic, and other organic acids, and in non-oxidizing acid chloride solutions, the makers state. In 20 percent hydrochloric acid at the boiling point the rate of penetration of the solution is only 0.0016 in. per month.

The new alloy is composed of nickel, molybdenum, and iron. In this respect it is similar to Hastelloy A, except that the proportion of iron has been decreased and the molybdenum content increased. The increase in molybdenum content results in a higher ultimate tensile strength and higher yield point, with practically no loss in ductility or in reduction of area.

Ideco "Giant" Series Drawworks

THE International Derrick and Equipment Company has introduced a series of drawworks called the "Giant" series. In these units this company, with their enclosed "pressure-spray" oiling system, pioneered the field, it is stated, in a pump-driven oil-circulating system for the chain, which arrangement, with the use of cut-tooth sprockets and oil-tight chain housings, reduces chain wear to a minimum. In this design the oil is pumped from a reservoir to the chain housings, sprayed on the chain, and returned to the reservoir, keeping fresh, clean oil on the chain at all times. The chain housings are sealed completely, protecting the chain from any sand, grit, or other foreign materials. Cut-tooth sprockets are used throughout, including the rotary and engine-drive sprockets.

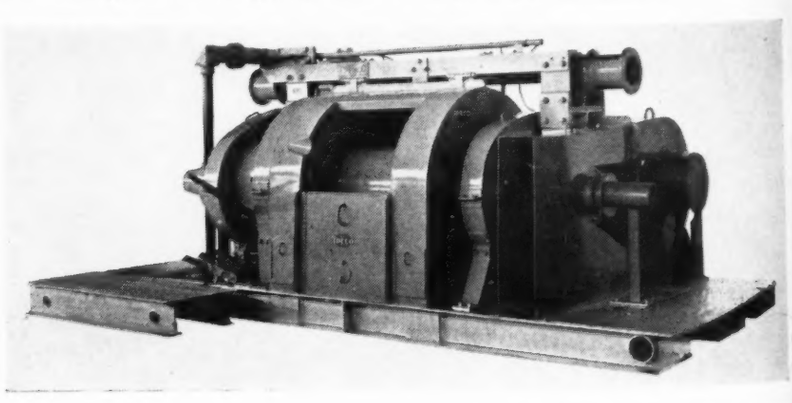
These drawworks have other outstanding features, including the following:

A rugged unit-type frame; heavy-duty self-aligning roller bearings for the line and drum shafts; water-cooled brake flanges; self-energizing compound equalized brakes with patented adjuster, and lubricating panel fitted with individual Alemite connection for each main bearing; floor-type catline rope roller guard.

The "Big Giant" is the largest model of the series, and is designed for drilling deep wells. This drawworks is equipped with a giant drum spool that increases the life of the wire rope and provides greater hoisting speeds at a given chain speed, the manufacturers state. Double-strand chain is used for the three drum drives, and on one installation, after drilling approximately 38,000 ft., the chain showed no sign of wear, they state.

The second model of the series is the "Junior Giant." It is designed for deep-well drilling up to 10,000 feet. One unit recently completed a well at a depth of 8700 ft., and its operation under these conditions was ideal, the makers say.

The "Little Giant" is constructed with the same features as the other two models, and is designed for drilling to approximately 6000 feet.



†"WEAPONS OF THE WEAK" – by Charles M. Russell

Today's Industry Reflects the Museum's Art

True art transcends eye appeal and becomes a practical servant of mankind. In this sense Axelson Pumps and Sucker Rods are truly works of art. ☆ Knowledge and skill handed down from the bronze age have been supplemented by knowledge and skill of the twentieth century. Man's control and use of metals have risen to amazing heights. The minds and hands of living men are daily employed in designing and processing selected steel to meet the demands of the petroleum industry. ☆ Axelson Pumps and Sucker Rods are the culmination of art and artisans for the practical purpose of producing oil. ☆ Axelson Manufacturing Company, P.O. Box 710 – Vernon Station, Los Angeles. St. Louis, Missouri. 50 Church Street, New York City. Tulsa, Oklahoma. Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation. Rocky Mountain Distributor: Great Northern Tool and Supply Company.

☆ ☆ ☆

† Charles M. Russell had a great understanding of the West and its creatures. In this bronze, a mother bear with her two cubs has climbed on a wobbly rock for safety, as they watch a porcupine go by. Although the "porky" is small, all other animals respect his armour. ☆ This is the first time that permission has been granted for the reproduction of this bronze. A reproduction of this picture, suitable for framing, is available upon request.

AXELSON PUMPS AND SUCKER RODS

Martin-Decker Slush Pump Gauge

MARTIN - DECKER Corporation has announced a new slush pump gauge that the makers believe will fill a long-felt need in the industry. The selection of a mud pump gauge heretofore has offered a serious problem. Its range should be high enough to cover those infrequent peaks encountered in drilling, such as when cementing, breaking circulation, etc., and yet the pressure gradations should be sufficiently spaced to permit accurate reading of the ordinary low pump pressures encountered in every-day drilling.

Martin-Decker has combined both features in one unit. Through an ingenious arrangement in the pressure element, the first 1500-lb. pressure is spread over 240 deg. of dial circumference, allowing easy and accurate vernier readings on all low-pressure work, and quickly shows the small pressure variations that occur when tool joints, connections, or fluid passages in the bit pump out. The last 1500 lb. are condensed on only 60 deg. of dial circumference, or one-fourth the spread of the first 1500 lb., and thus permit reading of peak pressures up to 3000 lb. with complete safety.

This new type mud gauge is available in a streamlined case that is recessed for the mounting bolts and provides a smooth exterior surface without projections to catch the clothing. This improved mud gauge element also is available to replace the regular mud gauge element in the older Quintuplex instruments and it readily can be installed without the need of special tools.

Complete information can be obtained from Martin-Decker Corporation, Long Beach, California.

Royal Portable Water Softener

THE ROYAL Portable Water Softener, manufactured by the Royal Manufacturing Company, Tulsa, Oklahoma, was designed specifically to meet the requirements of the oil-well driller. Even the dirtiest and hardest creek water can be passed through the unit and be sparkling clear and free of all scale-forming salts when it enters the boiler, the makers state.

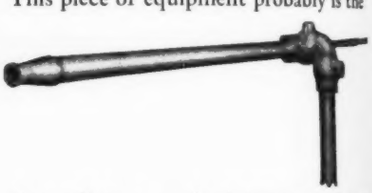
The Royal Portable Water Softener is known as a zeolite water softener. A special high-capacity green sand zeolite is used that has the additional property of functioning as a filter to remove dirt and other foreign matter. To obtain clear, clean, soft water the proper valves are opened and the water passed through the bed of zeolite. An electric alarm meter records the volume of water passing through the unit and rings an alarm bell when it is time to change from one unit to the other and regenerate the first. Regeneration is accomplished by simply introducing a brine solution from a brine tank by means of a hydraulic ejector that regenerates the mineral in the unit and leaves it ready for another run. The cheapest grade of common salt is employed to make the brine and it is the only chemical required.

Zeolite actually is a mineral obtainable in two ways. The synthetic type has a high capacity but its pores clog quickly when contaminated water is used and consequently is unsatisfactory for drilling work. The green sand type of material that is mined and processed ordinarily is of too low capacity for practical use of this kind, since it would require extremely large tanks for transportation. The Royal Manufacturing Company has developed a new-type high-capacity green sand zeolite that effectively acts as filter and has a high enough capacity so that smaller, easily portable, tanks can be employed. This green sand chemically is known as sodium aliminum silicate. When water passes through a bed of this zeolite, or sodium aluminum silicate, then any salts of calcium or magnesium that are in the water gradually change the mineral from sodium aluminum silicate to calcium or magnesium aluminum silicate and the sodium passes on in exact amount to replace the calcium or magnesium given up. Calcium and magnesium are salts that are classed as hardness and which cause scale and sludge in the boiler, and since these salts are left in the mineral and are exchanged for sodium, which does not form scale, the process is called "softening."

The Royal Portable Water Softener therefore consists of a combination of two softening tanks, with brine tank, mounted on skids and completely fitted with the necessary valves, piping, meters, mineral, etc., ready to operate.

Chiksan Mud-Mixing Gun

THE Chiksan Oil Tool Company has developed a gun designed especially for the purpose of mixing mud. This piece of equipment probably is the



first efficient mud-mixing gun offered to the oil industry, and fills a great need, the makers state, as it can be used on either mud pit or tank installations.

The gun consists of a Chiksan high-pressure steel swing joint to which is connected a 4-ft. nozzle. A handle is provided that has sufficient length for easy operation of the gun, and the nozzle has a special abrasion-resisting steel tip with a 7/8-in. opening. This nozzle tip is shaped carefully to give a streamlined, compact flow and insures the maximum amount of jetting action.

Double-ball races in each joint permit complete 360-deg. rotation in both a vertical and a horizontal plane, and the patented packing method used in the Chiksan joint insures complete and easy rotation at both low and high pressures without leaks, it is stated.

Information on this new equipment item can be obtained from the Chiksan Oil Tool Company, Fullerton, California.

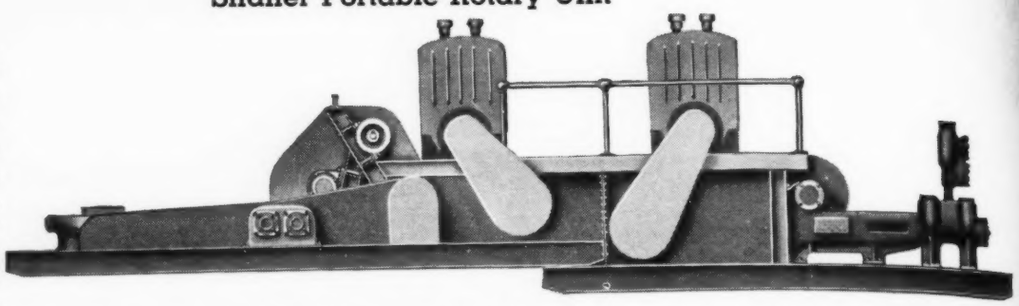
Where well loads approach capacity, unit pumpers get their real test. Under such conditions, the factors of safety built into every part of National Unit Pumpers insure their dependability.

National

THE NATIONAL SUPPLY COMPANY OF DELAWARE

DIVISION OFFICES: PITTSBURGH, PA., FORT WORTH, TEXAS, TULSA, OKLA., TORRANCE, CALIF. · MAIN OFFICE: TOLEDO, OHIO

Shaffer Portable Rotary Unit



INCREASING demand for light portable units has prompted the designing of the new-size Shaffer portable rotary drilling unit, manufactured by the Shaffer Specialty Company, Tulsa, Oklahoma. All power transmission equipment in this unit is adequate to meet field conditions and load demands with a high factor of safety, its makers state. The unit is designed for drilling to depths of 3000 to 4000 ft. using 3-in. drill pipe, and to 2500 to 3000 ft. with 4-in. drill pipe.

The Shaffer principle of rotary transmission drive has been applied to a light portable unit for drilling shallow wells.

The drawworks, rotary table, one engine with transmission shaft including forward and reverse, all are mounted permanently on one set of skids, movable in one load. The slush pump and one engine are mounted permanently on a set of skids and movable in one load.

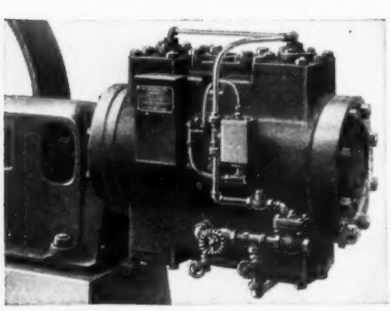
The separation is made between the engines for distribution of the loads, although the drawworks and engines can be constructed as one unit with the table and pump separate if desired.

Mounting the engines on top permits the shafting with chains and clutches to utilize the space beneath, thus maintaining the allowable road limit of 8 ft. in width. This unit is especially adaptable for use in the new Illinois field.

The Shaffer portable rotary drilling unit is designed for multiple-cylinder engine drive. It is simple in design, employing assembled parts of standard make, minimum in number and free from excessive wear.

Automatic Start-Stop Control and Unloader for Compressors

AUTOMATIC start-and-stop control, combined with automatic loading and unloading, can now be obtained without additional equipment on motor-driven single-horizontal compressors, by using the magnetic unloader introduced by Worthington Pump and Machinery Corporation, Harrison, New Jersey. No extra pip-



ing, valves, or other devices are required.

This device operates on standard electric equipment and can be installed wherever a conventional automatic starter is used for controlling the compressor motor. The only other provision necessary is a pressure switch to operate a pilot circuit. The pressure switch control is transferred electrically from the motor starter to the magnetic unloader, and either position may be selected at will. If connected to the motor starter, the compressor starts and stops on the demand for air. When connected to the magnetic unloader, the compressor runs continuously and simply loads and unloads depending upon whether or not air is needed. If desired, the cooling water supply also can be controlled automatically.

Another unusual feature in the design of this unit permits it to function as a starting and stopping unloader.

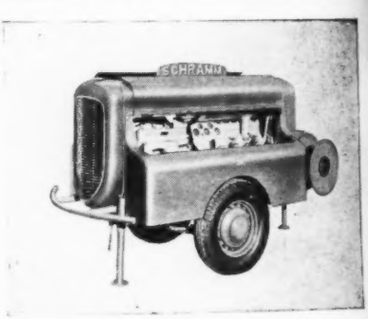
Complete information regarding the application and technical details can be obtained by writing the manufacturer.

Schramm Utility Compressor

IN keeping with the modern trend, Schramm, Inc., manufacturers, West Chester, Pennsylvania, have announced a new, lightweight air compressor. Two of the standard Schramm "Utility" models have been engineered into a DeLuxe package of air power for compressor users who recognize the need for a compact, lightweight, portable air compressor. This DeLuxe machine is available in sizes 85 and 105 cu. ft. actual air delivery in the gasoline engine-driven machines and in the 105 cu. ft. size in the Diesel-powered unit.

Compressor features include four cylinder, vertical block with lighter pistons; five main bearings; force feed lubrication supplied by gear-driven oil pump to all movable parts; mechanical intake valves operated from camshaft in perfect timing with piston travel; electric self-starting, and the Schramm self-aligning clutch between engine and compressor.

The DeLuxe "Utility" is a complete air plant with air and gas tanks compactly under the hood. This machine can be mounted on a half or three-quarters ton truck. The skid mounting of the outfit is a semi-portable one and has proved to be practical for mounting behind truck cabs on large trucks where it is not desirable to de-



vote the entire truck body to an air compressor. Two portable mountings are offered in the form of a two-wheel pneumatic tire spring trailer that can be towed at speeds up to 40 miles per hour and the truck mounted DeLuxe, resulting in a streamlined, portable outfit. DeLuxe features also include two spacious, streamlined tool boxes on either side of the machine. "Live-air" hose reels can be supplied as extras on DeLuxe models.

Write Schramm, Inc., West Chester, Pennsylvania, for Bulletin No. 3700-PE.

STAMINA

Fig. 1740 Gaso Duplex Piston Timken Bearing Power Pump, 54 to 250 Bbls.

• Many a fighter looks good during the first few moments of the battle . . . but it takes a real champ to stand up round after round under the grind of grueling punishment. Therein lies the secret of Gaso's championship . . . Gaso Pump & Burner Mfg. Co., Tulsa, Oklahoma. Export Office: 149 Broadway, New York.

Complete Gaso Condensed Catalog, in 1937 Composite Catalog.

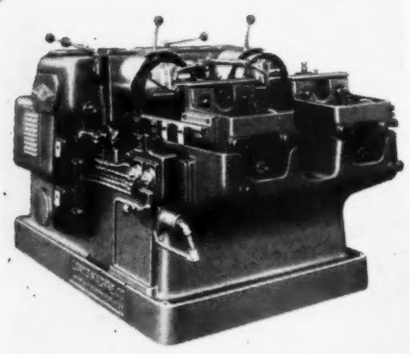
GASO PUMPS
for every oil industry need

Hydraulically-operated Machine for Turning Operation

THE Landis Machine Company of Waynesboro, Pennsylvania, recently designed a hyraulically-operated double-spindle machine for turning operations.

A series of experiments were conducted sometime ago in which a standard Landis lead screw machine was used for turning steering gear shafts. The threading dies were replaced by plain milling cutters in the die head.

The quality, insofar as accuracy and



finish were concerned, was so satisfactory that the possibilities in this new method of handling turning operations was immediately foreseen. The experimental machine was rather slow, and as production was an important factor, Landis engineers proposed the Lanhydro. The Lanhydro is a semi-automatic hydraulically-controlled machine designed to proceed through its entire cycle automatically with one tripping of the control lever.

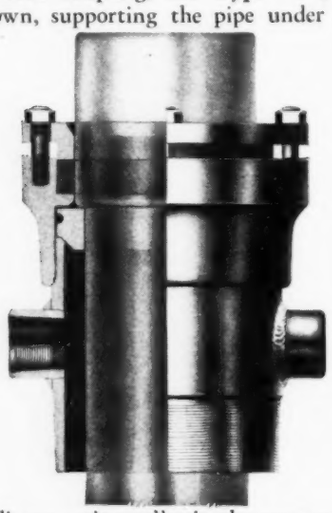
In general, the appearance of the Lanhydro is similar to the Landmaco threading machine and all the tested mechanical features of the Landmaco have been retained. A special centering device for supporting the work during the turning operation has been added. This special centering device consists of a female center backed up by a long spiral spring to keep the pressure against the work constant. The center travels back through the spindle with the advancement of the carriage. By using the travelling center to support the work, concentricity between the head of the shaft and the turned stem is assured.

The hydraulic unit and its control valve are of particular interest. A rapid feed is provided to carry the work to the turning head. A coarse turning feed is then used throughout the machining operation to a point within .008 in. to .010 in. of the shoulder. Where a shoulder must be faced, a very fine finishing feed is used. The length of the travel of the finishing feed is adjustable for any material or condition.

Low-Pressure Casing Head by Rector

A NEW, low-pressure casing head for medium- and shallow-depth wells has been added to the Rector head line by Rector Well Equipment Company, Fort Worth, Texas. It is the Type "C" head, 1000-lb. test, and constructed of drawn steel for the body and semi-steel for the cap. The quarter-section illustration herewith shows how ordinary pipe collar sits down on the Rector split-ring feature for suspending pipe.

The manufacturer describes the Type "C" head as having all the features of the original high-pressure Rector head except for the double collar, or recessed coupling, the Type "C", as shown, supporting the pipe under an



ordinary casing collar in the same manner as the 1500-lb. test Type "L" Rector head. Type "C" is full opening, has the repackability feature, the vertical loading feature that holds the weight of the oil string in direct line with the walls of the surface pipe, and has the regular Rector split-ring feature mentioned above.

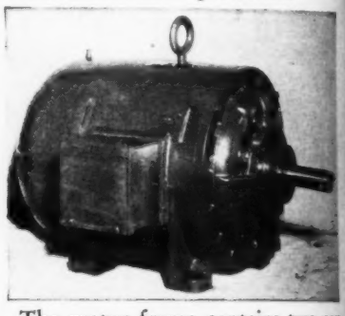
Placing of this head on the market now puts Rector Well Equipment Company in the low price field of casing heads.

Heavy-Duty Extinguisher for Trucks

HEAVY vehicle type Pyrene fire extinguishers with special "shock absorber" construction to withstand excessive vibration and fitted with specially-built sturdy-steel brackets in two styles for truck equipment are announced by Pyrene Manufacturing Company, Newark, New Jersey. One bracket is for mounting the extinguisher on the steering post and the other for any position on the dash or inside of cab. In addition to the conventional retaining cup at bottom and spring clips at top these brackets hold the extinguisher firmly and securely by a metal strap extending around the extinguisher with quick-opening spring buckle that readily and instantly releases in an emergency. The manufacturers are already supplying these extinguishers and brackets to common and contract carriers who come under the new I. C. C. safety equipment regulations and various state regulations.

Fan-Cooled Squirrel-Cage Motors

PROTECTED against abrasive dust, moisture, and corrosion, a new design of dual ventilated fan-cooled type CS squirrel-cage motors has been announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania. Designed for use where severe service is required, they also may be installed outdoors without additional protection.

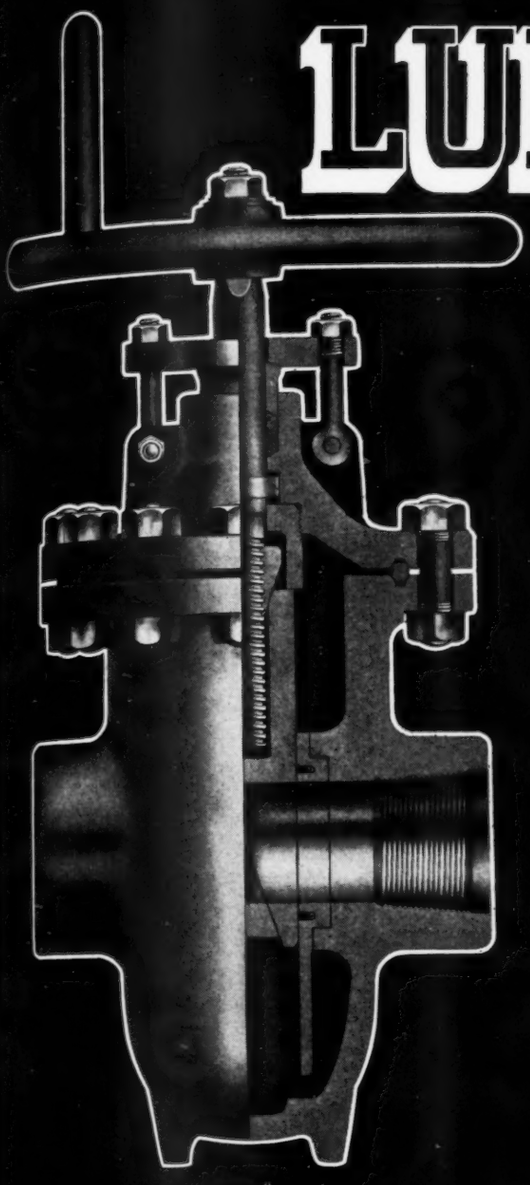


The motor frame contains two separate sets of air ducts, one set internal and one set external. The internal ducts are open in the interior part of the motor and the external ducts are open on the outside of the motor frame. These two sets of ducts are separated by a common wall.

The heat exchanger principle is used for cooling. An internal fan on the rotor circulates warm internal air through the internal ducts, the walls of which are cooled by the external fan blowing larger volumes of cool air through the external ducts, providing rapid transfer of heat from the motor, insuring long insulation life.

The housing is designed so that fresh grease enters the outside edge at the top of the bearing and excess or used grease is discharged at the bottom inner edge to the overflow sump. Since adding fresh grease automatically cleans the used grease from the bearing, it is unnecessary to incur the expense of periodically dismantling the motor to clean the bearings.

LUBRICATION



EVERY MOVING PART WORKS IN A BATH OF GREASE!

Design of the W-K-M Valve permits a method of lubrication not possible in any other gate valve. The body itself serves as a grease chamber . . . the 3-inch valve, for example, holding 6 pounds of compression grease. The gate and segment are thoroughly lubricated at each operation. This means easy opening and closing even at full rated pressure, complete freedom from internal corrosion, and a minimum of friction. Positive lubrication of this kind is one of the numerous features which place the W-K-M Gate Valve in a class by itself.

It's different!

COSTS NO MORE THAN ORDINARY VALVES

Sold Through Supply Stores Everywhere

W-K-M Company, Inc.

OIL FIELD . PIPE-LINE & INDUSTRIAL EQUIPMENT

HOUSTON, Texas, U. S. A.

Export Office: 74 Trinity Place, New York

Cable Address: "WILKOMAC"

The 4 W-K-M Valve types presented below embody the same patented features and together eliminate 95% of all gate valve troubles.

QUICK OPENING TYPE

HIGH PRESSURE STEEL

MEDIUM PRESSURE SEMI-STEEL

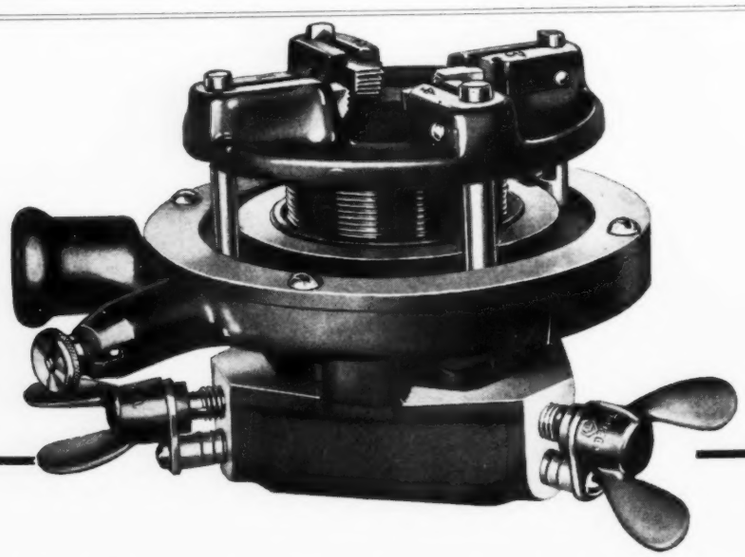
LOW PRESSURE IRON BODY

E. H. Poe New Secretary Natural Gas Department A.G.A.

E. Holley Poe, Tulsa, Oklahoma, who has been affiliated in an executive capacity with the Central States Power and Light Corporation, has been made secretary of the Natural Gas Department, American Gas Association, to succeed Captain A. E. Higgins who resigned to become vice-president of the Pittsburgh Equitable Meter Company, Pittsburgh, Pennsylvania. Headquarters of the department are in Dallas, Texas.

E. H. POE

Poe has been connected with the oil and gas industry since 1916. January 1 of that year he was employed by the Slick Oil Company and when that company was sold to the Sinclair Oil Company he went into business for himself, building and selling several gasoline plants. On September 1, 1918, he joined the staff of the Tidal Oil Company. In 1920, together with several associates, he formed the Wooster Oil Company, the Henryetta Gas Company, and the Tiger Mountain Oil Company, with headquarters in Tulsa. He stayed with this group until September, 1927, when the gas producing, transportation, and distribution properties of the companies were sold to the Central States Power and Light Corporation, Tulsa. Poe joined the Central States organization, where he has remained until his recent appointment.



A 1" to 2" THREADER

. . . that is unequalled for use in the field.

No bushings. Three broad-faced chuck jaws with large wing-head thumb screws and size-marked guide bars make this tool easy to center on the pipe. Long life pipe holder. Minimum wear.

Die receding principle and separate set of dies for each size assures good threads and easy operation.

The "TOLEDO" No. 1BR threads 1", 1¼", 1½", and 2" pipe. Sold by leading Oil Well supply dealers. Catalog covering complete line sent on request.

THE TOLEDO PIPE THREADING MACHINE COMPANY

TOLEDO, OHIO NEW YORK OFFICE, 72 LAFAYETTE STREET

"TOLEDO"

EFFICIENT EASY OPERATING

Stuart T. Penick Transferred to Houston by Link-Belt

STUART T. (Red) PENICK, who has been with Link-Belt Company for the past two years in an engineering capacity, was transferred to the Houston office recently, where he will devote his time to engineering development work on Link-Belt oil country chains, mud vibrating screens, RC roller chains, flexible couplings, anti-friction bearings, and pillow blocks, working under the direction of Pete Wallace, oil country division manager.

STUART T. (RED) PENICK

Penick was graduated from the University of Texas school of mechanical engineering in June, 1935, and joined the engineering staff of Link-Belt Company immediately thereafter. In order to become thoroughly acquainted with the company's equipment and its application he has spent the past two years in the Ewart Works at Indianapolis, the Dodge Works and the plant at Philadelphia.

Eddy Visiting Petreco Houston Branch

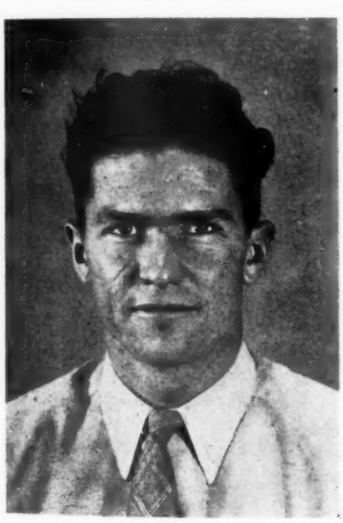
H. C. Eddy, chief engineer of the Petroleum Rectifying Company of California, Los Angeles, is at the company's Houston branch for extended conferences with the staff there on various new designs and engineering features of Petreco electromatic dehydration and de-salting equipment. Eddy also is reviewing the accomplish-

ments and future program of the Houston laboratory and will coordinate its work with that of the company's laboratory at Long Beach, California. During his stay he will inspect a number of Petreco plants in the Gulf Coast fields.

H. C. EDDY

Eddy reports that considerable interest is being shown in the Petreco electromatic de-salting process and that the company now has de-salting plants operating in Kansas, Oklahoma, Arkansas, Kentucky, and Michigan; while at this writing additional plans are being drawn up for installations at various Texas and Ohio refineries. Before returning to his Los Angeles office he may extend his trip in order to visit some of these plants.

BJ Stations Nicholson in Louisiana Fields



GARTH NICHOLSON

Byron Jackson Company, Los Angeles, has added Garth Nicholson to the sales force of its Oil Tool Division to cover Southern Louisiana. Nicholson will have headquarters at 213 West Main Street, New Iberia, Louisiana, for the sales and service of BJ oil tools in the coastal area.

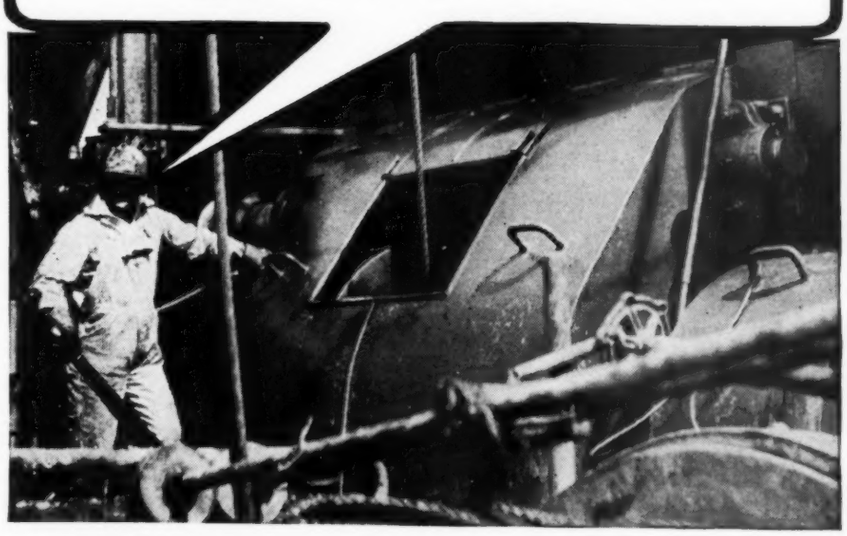
Johnston Oil Field Service Corporation Opens Executive Offices

Johnston Oil Field Service Corporation, exclusive licensee of the Johnston Formation Testing Tool in the Gulf Coast and Mid-Continent, and other states except the West Coast, announces the opening of executive offices at Suite 844, First National Bank Building, Houston, Texas. The manufacturing plant and main service depot is at 131 Harvard Street, Houston, and branch field operating points are maintained at central working points throughout the active oil areas.

New Enduro Steel Distributors

To the growing family of Enduro Stainless Steel distributors several recent additions have been made, according to an announcement by N. J. Clarke, vice-president in charge of sales, Republic Steel Corporation, Cleveland, Ohio. The new distributors are Huey & Philp Hardware Company, with warehouses at 1900 Griffin Street, Dallas, and at 2310 Main Street, Houston, Texas, and Star Steel Supply Company, 7522 Oakland Street, Detroit, Michigan.

HERE'S A LINING THAT CAN STAND THE GAFF!



TOM SINGLER operating one of the largest and best drilling rigs in the Corpus Christi oil fields, owned by W. A. Richardson Petroleum & Drilling Corp., and equipped with J-M Giant Rotary Lining, Style 410. Both owner and driller are sold on the superior, longer service of this rugged brake lining.

Here's why J-M Lining, Style 410 is the choice on so many Drilling Rigs:

AN EVEN FEED-OFF
. . . assuring better controlled drilling.

LESS SMOKING AND DUSTING
. . . working conditions greatly improved.

SCORING TENDENCY REDUCED
. . . life of brake rim is lengthened.

QUIETER BRAKES
. . . less nerve strain on drilling crews.

Johns-Manville
GIANT ROTARY LINING
Style 410
JM

WRITE NOW—for full details on our complete line of friction materials. Address Johns-Manville, 22 East 40th Street, New York City.

Tribute to Macwhyte Company

An impressive tribute to the Macwhyte Company, Kenosha, Wisconsin, was made by the Kenosha *Evening News* on May 26, which published a large special edition to commemorate Macwhyte's 25th anniversary as one of the city's major industries.

Picture pages graphically portrayed the precision methods employed by the company in the manufacture of high-grade wire, wire rope, braided wire rope slings, and cable and tie rods for aircraft.

The important part that laboratory research has played in the building of Macwhyte's position in the wire rope field also was stressed. Although celebrating its Silver Jubilee in Kenosha, the foundation for the present business was actually laid back to 1896 when George S. Whyte incorporated to sell wire rope on a brokerage basis. In 1901 Mr. Whyte put into effect some of his ideas on the improvement of wire rope and first began manufacturing operations.

The first plant was erected in Coal City, Illinois, with executive offices in Chicago. The company was known then as the Macomber and Whyte Rope Company. The entire business moved to Kenosha in 1902, and in 1920 the corporate name was changed to the Macwhyte Company.

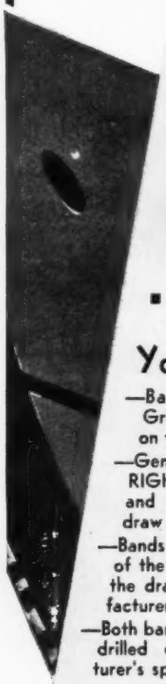
The products of the company now are used throughout the United States and in many foreign countries. George S. Whyte is chairman of the board of directors, Jessel Whyte is president and general manager, and H. E. Sawyer is vice-president and treasurer.

Solves YOUR BRAKE BLOCK problems

THE GRIZZLY ROTARY BRAKE BLOCK BAND EXCHANGE

by bringing you BRAKE BANDS RELINED WITH Genuine GRIZZLY FULL MOULDED BRAKE BLOCKS

. . . At No Extra Cost



You Get . . .

—Bands already lined with Grizzly Blocks . . . ready to put on your rotary rig.

—Genuine Grizzly Blocks of the RIGHT thickness, width, length, and radius for the particular draw works.

—Bands that are exact duplicates of the bands originally put on the draw works by the manufacturer.

—Both bands and blocks factory drilled exactly to manufacturer's specifications.

You Get Rid of . .

—Uncertainty as to getting the right lining for the job, the right size lining for the band, the correct drilling.

—The bother and interference of relining bands . . . all that is necessary is to install the new bands.

—Worn, warped trouble making bands . . . Under the Grizzly Band Exchange Plan such bands are turned in and junked.

A BEAR FOR WEAR

Under this convenient new plan you get bands delivered to you that are correctly curved to proper drum diameter; that insure perfect lining contact to the drum. It will pay you big dividends . . . in faster drilling, greater safety, and more ton miles of brake block service, while getting the benefit of the superior performance of Grizzly Full-Moulded Rotary Blocks. Leading supply houses stock Grizzly-Lined new steel bands for all types of rotary draw works . . . ask your supply man for complete details and prices.

E. M. SMITH COMPANY

600-650 SOUTH CLARENCE STREET, LOS ANGELES, CALIFORNIA

Sold in the Mid-Continent and Gulf Coast By All Leading Supply Stores

Warehouses in Oklahoma City, Oklahoma, and Houston, Texas

T. E. Sutter to Attend World Petroleum Congress in Paris

T. E. SUTTER

T. E. Sutter, vice-president and general manager of Baker Oil Tools, Inc., Huntington Park, California, sailed June 2 on the "Normandie" to attend the World Petroleum Congress in Paris, France.

In addition to attending the sessions of the Paris Congress, Sutter's itinerary includes visiting The Hague, points in Germany, Switzerland, and the British Isles. He will contact, in the interests of his company, various foreign representatives and customers of the internationally-known line of Baker oil tools.

Sutter is expected to return to the United States the latter part of August.

Petroleum Engineering, Inc. to Larger Quarters

Announcement is made that due to the need for more spacious quarters Petroleum Engineering, Inc., for the past seven years in the Philtower Building, Tulsa, Oklahoma, has moved to the National Bank of Tulsa Building.

D. R. Dale on Trip to Europe

D. R. Dale, research director for The S. M. Jones Company, manufacturers of sucker rods, has just concluded one of his frequent field trips to Oklahoma oil fields, and is now bound for Europe. Sailing on the Normandie, Dale will study latest developments in metallurgical circles in England, France, and Germany.

D. R. DALE

Dale states that since his first trip to the oil fields in 1919, sucker rod problems have been steadily on the increase. The growing need for factual data on pumping conditions and metallurgy has expanded to such an extent that The S. M. Jones Company now concentrates its factory engineering and research work in Toledo, and a field engineering department was established in Tulsa to keep in constant touch with pumping problems in the field. This combination of field and factory research and engineering by The S. M. Jones Company has behind it a long record of pioneering. The first of these improvements was 12 years ago when Jones introduced the high manganese steel sucker rod, because field studies indicated strength was the problem. Then followed developments in heat treating. Next came low metalloid rods, and today the industry is in accord on selecting sucker rods to fit pumping conditions.

Dale's work in engineering and research is well known in the industry, and part of his time is devoted to A. P. I. work. He is now chairman of the Manufacturers Sub-Committee on Sucker Rods, and a member of the Pumping Equipment and Materials Committees.

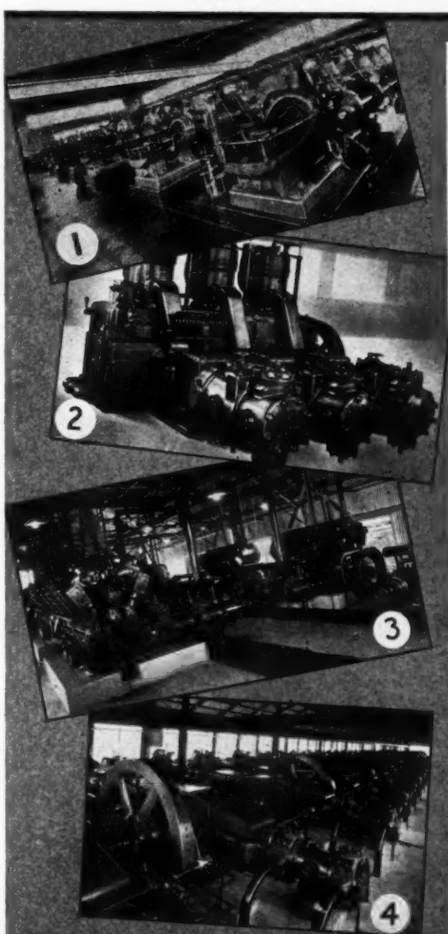
L. L. Aubert Chairman of A.P.I. Pacific Coast District for 1937-8

L. L. Aubert, of Bankline Oil Company, Los Angeles, California, has been elected 1937-38 chairman of the Pacific Coast District of the American Petroleum Institute's Division of Production. W. G. Corey, of Pacific Gear and Tool Works, Los Angeles, is treasurer, and D. S. Kilgour, of California Oil and Gas Association, Los Angeles, is secretary.

The new vice-chairmen are: Los Angeles Basin, Howard C. Pyle, Union Oil Company of California, Los Angeles; Coastal District, W. L. Bagby, Shell Oil Company, Ventura, California; and San Joaquin Valley, J. H. Sargent, Kettleman North Dome Association, Avenal, California.

W. L. McLaine, of General Petroleum Corporation, Los Angeles, is the new chairman of the District Advisory Committee. Following are members: L. A. Granson, Honolulu Oil Corporation, San Francisco; W. N. Lacey, California Institute of Technology, Pasadena; H. F. Owen, Ethel D. Company, Maricopa; R. L. Patterson, United States Geodetic Survey, Taft; L. C. Uren, University of California, Berkeley; and the following from Los Angeles: Bruce Barkis, Lane-Wells Company; A. H. Bell, Continental Oil Company; Elmer Bolton, The Ohio Oil Company; H. S. Cole, Jr., The Texas Company; W. H. Geis, Super Asphalt Company; Dana Hogan, Hogan Petroleum Company; Joseph Jensen, Tide Water Associated Oil Company; L. B. Little, Standard Oil Co. of California; H. M. Macomber, Pacific Western Oil Company; F. E. Rehm, Shell Oil Company; William Reinhardt, Union Pacific Railway; A. C. Rubel, Union Oil Company of California; R. E. Stearns, Universal Consolidated Oil Company; A. E. Wallace, Western Gulf Oil Co., and W. C. Whaley, Barnsdall Oil Co.

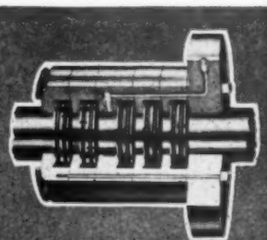
Seal your reciprocating piston rods
the way so many engine and compressor builders do . . . with
COOK'S METALLIC PACKINGS



Any engine or compressor is a more efficient unit if its rods are fitted with COOK'S METALLIC PACKING. The leading engine builders recognize this fact. Noteworthy applications are represented by the equipment, shown in the accompanying illustrations, that comes factory-equipped with COOK'S PACKINGS.

There is an approved type for all pressures fitted with packing rings made of COOK'S GRAPHITIC IRON, Cookmet, Babbitt or Micarta, as the requirements of service suggest.

For existing equipment, communicate with us direct or our nearest branch office.



1-COOPER-BESSEMER CORP.
2-CLARK BROTHERS COMPANY
3-INGERSOLL-RAND COMPANY
4-WORTHINGTON P&M CORP.

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MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.
NEW YORK • LOS ANGELES • CHICAGO
NEW ORLEANS • CLEVELAND • TULSA
BALTIMORE • SAN FRANCISCO

Crane Co. Consolidates Sales Departments

P. R. Mork, vice-president in charge of sales, Crane Co., Chicago, Illinois, announces the coördination of all activities concerned with the estimating, engineering, or sales of valves, fittings, pipe, and fabricated piping into one

W. H. PAPE

unit, the Valve and Fitting Department, with W. H. Pape as manager. Pape enters his new position with 25 years' experience covering a wide range of industrial applications of Crane products. His first activity was in heavy railroad construction, followed by similar work on New York subways. In 1914 he entered the oil industry, serving subsequently as designer, operator, and sales engineer. He joined the Crane organization in 1927 as special representative in New York and later in the Boston territory. For six years he was in the Oklahoma and Gulf Coast oil fields, and for the past one and one-half years has been manager of the Oil Sales Department in the general office, Chicago.

The former Industrial Sales Department and Engineering Sales Department are consolidated into a new section—the Engineering Sales Section of the Valve and Fitting Department with E. Burke as manager of this section, G. F. Wright, assistant manager in charge of estimating and other activities dealing with fabricated pipe and allied products, and W. F. Lahl, assistant manager, supervising the industrial zone men in the field. J. H. Barker is manager of the sales quotation section of the Valve and Fitting Department. Other sections of the new consolidated department include pipe sales, marine sales, oil sales, railroad sales, and water works sales.

Geo. S. Whyte Made Chairman of Board of Macwhyte Co.

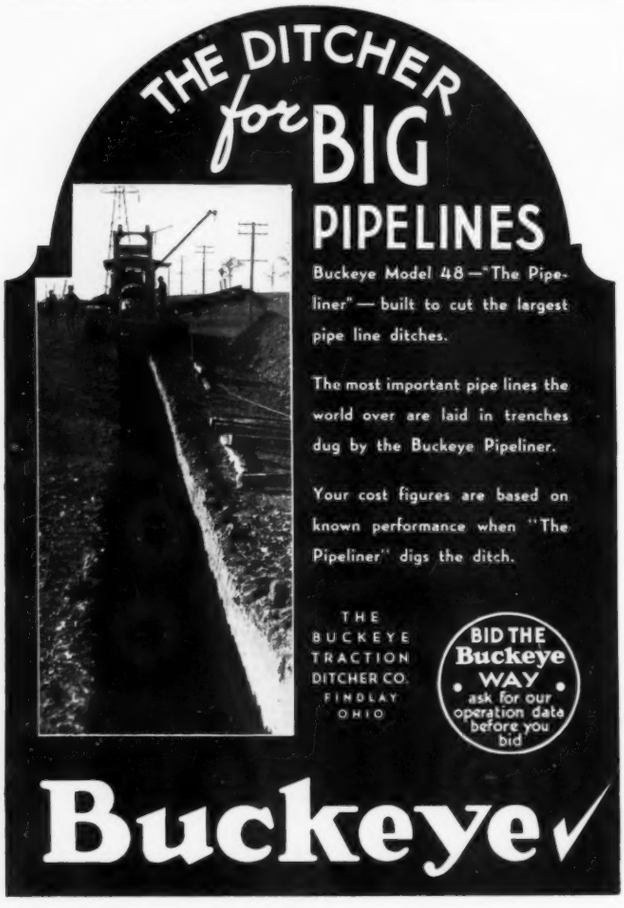
Announcement has just been made by the Macwhyte Company, Kenosha, Wisconsin, that Geo. S. Whyte, formerly president, was elected to the newly-created office of chairman of the board of directors at the company's annual stockholders meeting held May 25.

GEO. S. WHYTE

At the same time, Jessel S. Whyte, former vice-president and general manager, was elected president and general manager, succeeding his father in the former capacity. H. E. Sawyer was re-elected vice-president and treasurer and director, and continues as general sales manager.

Other members of the board are Robert B. Whyte, newly elected, and W. Robert Johnston.

The board of directors also voted another distribution of profits to employees, as has been the policy of the Macwhyte Company for a number of years.


THE DITCHER for BIG PIPELINES
Buckeye Model 48—"The Pipeliner"—built to cut the largest pipe line ditches.
The most important pipe lines the world over are laid in trenches dug by the Buckeye Pipeliner.
Your cost figures are based on known performance when "The Pipeliner" digs the ditch.
THE BUCKEYE TRACTION DITCHER CO. FINDLAY OHIO
BID THE Buckeye WAY • ask for our operation data before you bid
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The Strength of This
Sucker Rod Elevator
is Guaranteed
B - M - W
Neilson Type C
Bodies of molybdenum steel with forged bails. Easily operated. Safe. Spring and plates quickly replaceable. Interchangeable plates. Two latches. Each latch, alone, will hold the rod. Two sizes — for light and heavy duty.
Principal B-M-W Products are obtainable at supply stores, including • ADMORE Insert Pump Anchors; • NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); • BALLS and SEATS (made for every pumping service); • ADMORE Liner Barrels; • TEX TYPE Plunger Fittings and Valves; and • COLLINS Belt Clamps.
BRADFORD MOTOR WORKS INC
OIL WELL SUPPLIES
BRADFORD, PA. — TULSA, OKLA.

New Book by Dr. Gustav Egloff

DR. GUSTAV EGLOFF

Doctor Gustav Egloff has written a book, "Reactions of the Pure Hydrocarbons," into which have gone the experience and the learning of more than 20 years devoted to research and development to produce more and better gasoline.

As director of research of Universal Oil Products Company, Dr. Egloff has played an important part in the development and improvement of the Dubbs cracking process. He also is active in the development of catalytic polymerization, which today is an important factor in refining, and of other processes that are approaching commercial status or are in the incubation stage.

He is the author of more than 300 articles relating to petroleum chemistry and technology, and more than 250 patents have been issued to him in this and other countries.

"Reactions of Pure Hydrocarbons" is being published by Reinhold Publishing Corporation. It will be off the press shortly.

New Account for McGregor and Thilenius

McGregor and Thilenius, engineering service and sales, Suite 201 Midco Building, Tulsa, Oklahoma, have been appointed representatives in Oklahoma and Kansas for the Sealed Power Corporation, Muskegon, Michigan, manufacturers of piston rings of all sizes and types.

McGregor and Thilenius already are representing, in their territory, Byron Jackson Company, Johnson and Jennings Company, "Oceco" Division, F. H. Maloney and Company, Palmer Company, Simplex Valve and Meter Company, and the Staynew Filter Corporation. The firm is composed of John M. McGregor and Fred Thilenius.

Annual Picnic of Axelson Employes

The Axelson employes' eighth annual picnic, held May 22 at Montebello Stadium, Montebello, California, drew one of the largest turnouts in the history of this yearly event. Many friends of the Axelson personnel were in attendance and contributed toward making the picnic an outstanding success.

From 9 o'clock in the morning until late in the afternoon, athletic events for men, women, and children literally kept the crowd on its toes. The program started with a ball game between teams from the machine shop and the foundry and ended with a three-legged race for men. Interspersed were foot races for boys and girls, a tug-of-war, a horseshoe-pitching tournament, an egg-throwing contest, and a race for fat men and fat women.

The day's festivities were climaxed with a dance in the evening.

Ray Humphreys, Axelson's assistant director of sales, was a busy master-of-ceremonies throughout the day. Charlie Davis was chairman of the program committee.

Use this automatic J-M Packing for greater efficiency . . . for lasting protection against costly shutdowns

NO ORDINARY PACKINGS—these Johns-Manville Sea Rings! They not only last longer—but also, they reduce wear on rods—minimize your power requirements.

For Sea Rings are *absolutely automatic!* The flexible lip is held tightly to the rod on the work stroke by the pressure of the liquid, but releases on the return. Result—unnecessary friction is eliminated. And that means less wear on equipment . . . greater savings in power costs.

Then, too, the extra service provided by this long-lasting packing obviates frequent replacements and consequent shutdowns. In every respect, therefore, they are the best packing for reciprocating rods and plungers used in service against oil, steam, hot and cold water, air or brine.

* * *

For full details on Sea Rings, and on the complete J-M line as well, write for our PackingsCatalog. Address Johns-Manville, 22 East 40th Street, New York City.

Johns-Manville PACKINGS & GASKETS

Book Reviews

Petroleum Production. By W. F. Cloud. Published by University of Oklahoma Press, Norman, Oklahoma. 613 pp. 75 tables. 280 drawings. Price, $5.00.

The author, associate professor of petroleum engineering in the University of Oklahoma, has prepared this volume to serve as a treatise on petroleum production methods and fundamentals. The entire subject of development and production has been covered as completely as is possible in a volume of this size. Among the subjects treated are methods, equipment, and fundamentals of development and production; geological problems and oil well drilling as related to oil well completion and operation; production of natural gas and gas well operation; methods of preventing waste and improving the economy of production practices; methods of increasing the ultimate recovery of oil; and sufficient legal subject matter has been included to acquaint the average individual with the preliminary details of acquiring exploratory rights.

The volume is liberally illustrated with drawings, tables, and photographs, and an excellent bibliography is included at the end of each chapter.

* * *

Lessons in Arc Welding. Published by The Lincoln Electric Company, Cleveland Ohio. Mimeographed. Simulated leather binding. Price, 50 cents, postpaid, in the United States; elsewhere, 75 cents.

Lessons in Arc Welding provide arc-welding operators and other interested individuals with a thorough working knowledge of the practical application and use of arc welding. The lessons have been reissued in considerably enlarged form. The volume, profusely illustrated by sketches, now contains 44 lessons and approximately 130 pages, compared with 28 lessons and some 60 pages in the original edition. The lessons are based on the course in arc welding that has been conducted by the company in its plant welding school for nearly 20 years.

The volume, beginning with general fundamental suggestions, takes the student by easy stages through all the important phases of practical arc welding and affords him thorough instruction on the subject.

* * *

Gulf Coast Oil Fields. Edited by Donald C. Barton, Humble Oil and Refining Company, and George Sawtelle, Kirby Petroleum Company. Published by The American Association of Petroleum Geologists, Box 1852, Tulsa, Oklahoma. Obtainable from the association or Thomas Murby and Company, 1, Fleet Lane, E. C. 4, London, England. 1084 pp. 292 line drawings. 19 halftone plates. Bound in blue cloth, gold stamped, paper jacket, 6x9 inches. Price, $4.00, express or postage free; $3.00 to A.A.P.G. members and associate members.

The volume is comprised of 54 papers reprinted from the *Bulletin* of the American Association of Petroleum Geologists, originally presented at the Houston, Texas, meeting in 1933, with a foreword by Mr. Barton. These papers supplement an earlier volume published by the association on the *Geology of Salt Dome Oil Fields*, advancing the record on the area from 1924 to the present.

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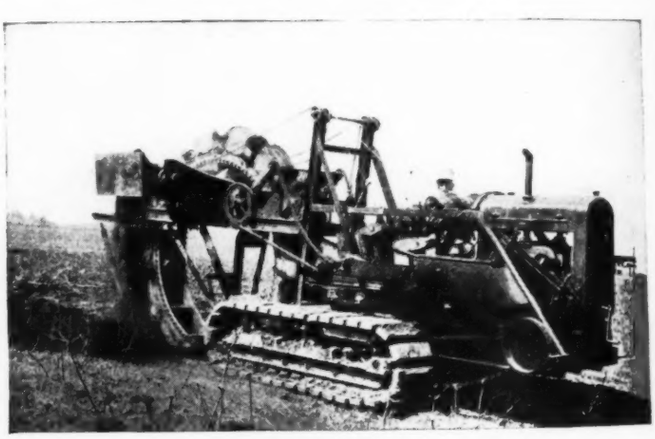

Records on hundreds of miles of work show substantial savings with the "Cleveland Model 110." Because they are built to meet requirements, to do more work in more places in the shortest possible time, "Clevelands" have achieved deserved popularity.

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Another reason for "Cleveland's" pre-eminence. High-speed, low-cost transportation via special trailer. Loads or unloads in 10 to 15 minutes.

CLEVELANDS

Annual A.S.T.M. Meeting

During the week of June 28-July 2, the 1937, (Fortieth) Annual Meeting of the American Society for Testing Materials will be held at The Waldorf-Astoria, New York City. Throughout the week there will also be in progress the Fourth Exhibit of Testing Apparatus and Related Equipment.

In order to provide ample time for the presentation and discussion of the large number of papers and reports scheduled, upwards of 20 formal sessions are being planned. Some of these will be devoted entirely to symposiums comprising several groups of papers.

Details of the meeting are being developed by a local committee on arrangements headed by Dr. M. F. Skinker, assistant director of research, Brooklyn Edison Company. The officers of the committee and heads of the various subgroups are as follows:

Committee on 1937 Annual Meeting Arrangements:

Honorary chairman: H. S. Vassar, laboratory engineer, Public Service Electric and Gas Company.

Chairman: M. F. Skinker, assistant director of research, Brooklyn Edison Company.

Vice-chairman: W. H. Finkeldey, Member of Firm, Singmaster & Breyer.

Secretary: G. O. Hiers, chemist, National Lead Company.

Subcommittees and chairmen:

Entertainment Committee: J. R. Townsend, materials standards engineer, Bell Telephone Laboratories, Inc.

Program Committee: R. L. Hallett, chemist, National Lead Company.

Finance Committee: K. G. Mackenzie, consulting chemist, The Texas Company.

Publicity Committee: E. A. Snyder, insulating oil sales, Socony-Vacuum Oil Company, Inc.

Exhibit Committee: F. M. Farmer, vice-president and chief engineer, Electrical Testing Laboratories.

Membership Committee: J. M. Weiss, president, Weiss & Downs, Inc.

Ladies Committee: Mrs. William H. Bassett, Jr.

Clarifying Object of Lincoln Arc Welding Foundation Awards

Dr. E. E. Dreese, chairman of the Board of Trustees and of the Jury of Awards, The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, has issued a statement further clarifying the object of the Foundation's 14 Awards, totaling $10,500, for containers (tanks, etc; pipe lines, etc.), papers in its $200,000 series of awards. Such clarification is necessary, reports Dr. Dreese, in view of a feeling that apparently exists, that only individuals familiar with the use of electric welding have an opportunity to participate.

"The idea expressed in letters and reports from the field, that the opportunities of the Lincoln Foundation's Container Awards, are available only to individuals familiar with electric welding and its use, is entirely erroneous," states Dr. Dreese. "Although a definite object of the awards is to urge engineers, designers, and production managers to study container products such as tanks (contents stationary) and pipe lines (contents moving), which are now partially welded, so that electric welding may be applied more extensively, the primary object of the Fund is to encourage study of containers now built by some method so that electric welding may be used in construction.

"Ample time is allowed by the duration of the Foundation award program —closing June 1, 1938—for engineers to acquire sufficient knowledge of the principles of arc-welded construction to apply the method in redesign. To be suitable as subject matter for a paper, the container need not be built entirely by arc welding."

Col. Harry E. Stewart, Owner and Operator

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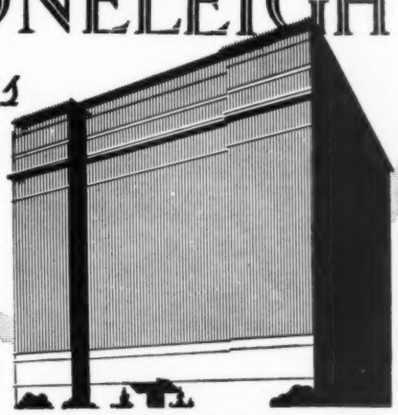
in the quiet atmosphere of the South's finest Hotel

The STONELEIGH *Dallas*

Maple Ave. at Wolf St.

Air Conditioned



Come to the GREATER TEXAS PAN AMERICAN EXPOSITION *Dallas*

STARTING JUNE 12TH

The Stoneleigh is the kind of Hotel that will increase immeasurably the enjoyment of your visit to Dallas. Located in the quiet residential district overlooking the city, the Stoneleigh offers comfort and luxury that is not extravagance in any sense. For service, food and accommodations here are always well within reason. Whether you come to Dallas on business or pleasure, your stay at the Stoneleigh will be an unforgettable experience.

DON E. STEWART MANAGER

THERE ARE DEFINITE REASONS

Why the BAKER *Model F CEMENT RETAINER provides a Better, Quicker, Safer Way to*

PLUG BACK—RECEMENT
CEMENT IN SERIES
TEST UPPER CASED FORMATIONS
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CEMENT UNDER PRESSURE
PLUG OFF BOTTOM FLUIDS
CEMENT BEHIND SECTIONS OF PIPE
and do Repair Work of All Kinds

. . . and these reasons are fully brought out in the BAKER BROADCAST No. 17, which describes and illustrates the design, construction, operation and many successful *laboratory and field proven* applications of the BAKER Model F CEMENT RETAINER.

Every oil executive and field man interested in the vital subject of cementing should have this comprehensive treatise on file.

You can get your copy by simply signing and returning this coupon . . . But DO IT NOW, as the supply is limited.

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Please send me a copy of the Baker Broadcast No. 17 describing and illustrating the design, construction and applications of the Baker Model F Cement Retainer. I understand this request incurs no obligation on my part.

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Forty Years of Service

At left, David B. Crawford, and, at right, John M. Crawford

THE 40th anniversary of The Parkersburg Rig and Reel Company was celebrated April 30, 1937. In commemoration of the occasion the employees presented silver loving cups to John M. Crawford, founder of the company, and David B. Crawford, president, as tokens of their loyalty and affection.

The presentation ceremony, attended by the department heads from the general offices and plant foremen, came as a complete surprise to both recipients. Casper A. Ruf, vice-president and general manager, and Bernard M. Farson, secretary and treasurer, made the presentations.

John M. Crawford and David B. Crawford are two of the supply industry's most widely known and popular figures. From the time they began their careers as salesmen in the Pennsylvania fields they have served a total of almost 100 years in this branch of the oil industry.

Mid-Continent Supply Opens Store at Turnertown

The Mid-Continent Supply Company, Mid-Continent Building, Fort Worth, Texas, has opened a new store at Turnertown, Rusk County, Texas, under the supervision of F. R. Files, manager, of the company's Kilgore, Texas, store.

Grizzle to Rocky Mountain Territory for BJ

JACK GRIZZLE

Byron Jackson Company, Los Angeles, announce the appointment of Jack Grizzle as sales representative in the Rocky Mountain area for BJ oil tools. He will make his headquarters at 345 South Park Street, Casper, Wyoming, from where he will cover all active fields, including periodic visits into Canada.

STRAIGHT TALK.... *about* CROOKED HOLES

Write for literature

SPERRY-SUN WELL SURVEYING CO.

1608 Walnut Street, Philadelphia, Pa.
425 Petroleum Building, Tulsa, Okla.
3118 Blodgett Avenue, Houston, Texas
549 East Bixby Road (3800 Block—Atlantic Ave.) Long Beach, Calif.
Bank of Lafayette Bldg., Lafayette, La.
c/o Elks Club, 17th and I Streets, Bakersfield, Calif.

Frank O. Prior Member of Executive Committee International Petroleum Exposition

Frank O. Prior, president of the Stanolind Oil and Gas Company, has been selected as a member of the executive committee of the board of directors of the International Petroleum Exposition, according to W. G. Skelly, president.

Along with other members of the executive committee Prior will take an active part in the promotion of the May 14 to 21, 1938, International Petroleum Exposition in Tulsa. Other

FRANK O. PRIOR

executive committee members are: Frank J. Hinderliter, Alf G. Heggem, W. M. Bovaird, Clyde H. Pape, W. G. Skelly, W. G. Way, general manager, and H. R. Powers.

Prior's first connection with the oil industry was with the Mid-West Refining Company in the Salt Creek field, Wyoming, joining that organization in 1919 after graduating from Leland Stanford University. When Stanolind Oil and Gas Company was organized in 1930 Prior became its first president. He is a member of the A.P.I., A.I.M.M.E., Mid-Continent Oil and Gas Association, and has been a member of the Tulsa oil show directorate for a number of years.

Earl M. Rees to Europe

EARL M. REES

Earl M. Rees, sales manager of the Fluid Packed Pump Company, Los Nietos, California, is making an extended business trip for the company. Rees left Los Angeles May 27 for New York, whence he sailed for England on June 4 aboard the S. S. Statendam. He will visit oil company headquarters in London and The Hague and will stop over in Paris to attend the World Petroleum Congress in June. From Europe, Rees will proceed to the East Indies for a tour of the principal oil fields, returning to Los Angeles late in September.

Moorlane Company Tulsa Distributor for Lycoming

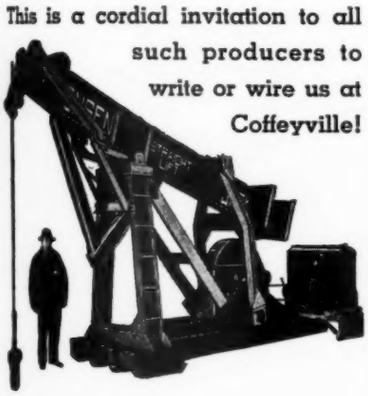
The Moorlane Company, 409 Archer Street, Tulsa, Oklahoma, has been appointed distributor for Lycoming natural gas engines and Lycoming natural gas engine generating units for the Tulsa territory, according to an announcement by the Lycoming Manufacturing Company, Williamsport, Pennsylvania. They will carry a full line of the Lycoming AG Series natural gas engines, as well as parts.

Lycoming's natural gas engines are for oil-well pumping, driving rotary and power pumps, and for generating electric light and power.

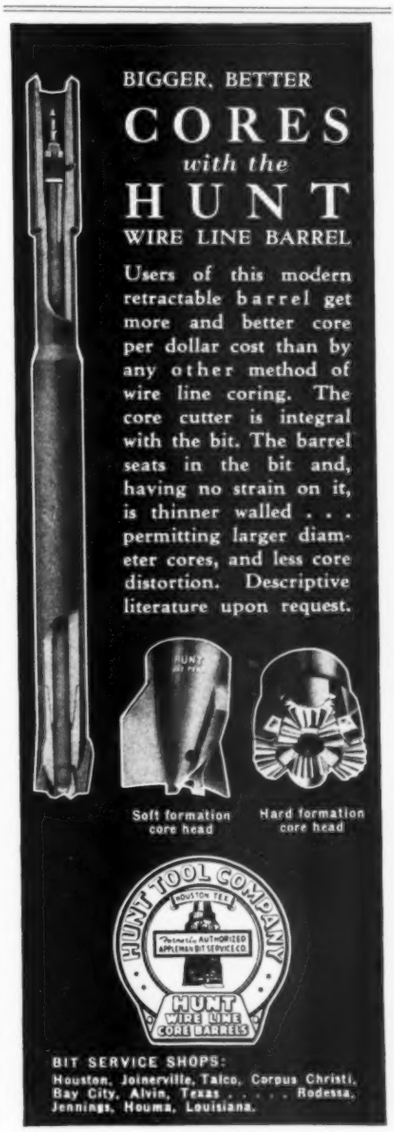
FRIED CHICKEN

...is something the average New Yorker has never tasted. And he doesn't know what he's missing! Same way with the producer who has never used a JENSEN Straight-Lift JACK. He is missing out on the finest piece of equipment ever developed for lifting oil. But he doesn't know it.

This is a cordial invitation to all such producers to write or wire us at Coffeyville!



JENSEN BROTHERS MANUFACTURING CO.
. . . Coffeyville, Kansas


BIGGER, BETTER
CORES
with the
HUNT
WIRE LINE BARREL
Users of this modern retractable barrel get more and better core per dollar cost than by any other method of wire line coring. The core cutter is integral with the bit. The barrel seats in the bit and, having no strain on it, is thinner walled . . . permitting larger diameter cores, and less core distortion. Descriptive literature upon request.
Soft formation core head
Hard formation core head
HUNT TOOL COMPANY
HOUSTON TEXAS
HUNT WIRE LINE CORE BARRELS
BIT SERVICE SHOPS:
Houston, Joinerville, Talco, Corpus Christi, Bay City, Alvin, Texas . . . . . Rodessa, Jennings, Houma, Louisiana.

M. E. Chapman Manager Tulsa Office Chemical Process Company

M. E. Chapman on May 15th became affiliated with the Chemical Process Company as manager of the Tulsa office, recently opened in the Thompson Building. He had been with the Gulf Production Company.

Chapman's first connection with the oil industry was in 1919 as a roustabout with the Mid-West Refining Company in Wyoming. Later he was with the Illinois Pipe Line Company, and then with the Humphreys Corporation on the Gulf Coast and at Nocona, Texas. After returning to the Colorado School of Mines and receiving a degree in petroleum engineering in 1927 he became technical advisor to the Argo Oil Company. In October, 1928, he joined the staff of the Gypsy Oil Company as assistant to R. S. Knappen, devoting his time to repressuring and pressure-maintenance work. When acidizing came into use he was active in its application. Recently his work with the Gulf had been devoted largely to reconditioning of wells, including shooting, deepening, plugging-back, and acidizing.

M. E. CHAPMAN

OTIS REMOVABLE BOTTOM HOLE CHOKE POSITIVELY PREVENTS FREEZING AT THE SURFACE CONTROLS!

- Set in the lower portion of the tubing in a high-pressure well, the choking is done in the higher bottom hole temperature, thus raising the temperature of production. Eliminates use of costly heating equipment at the surface.
- It reduces high tubing surface working pressure to trap or gathering line pressure, and practically eliminates cutting of surface connections.
- Chokes are run and pulled by experienced engineers, who determine proper choke diameter for desired rates of flow.
- Field proven in hundreds of high pressure wells over a period of years. Never has it failed to measure up to claims made for it.

PRESSURE CONTROL — OTIS — SERVICE – EQUIPMENT

OTIS PRESSURE CONTROL, INC.

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Hobbs, N. M. Houston, Texas Oklahoma City, Okla.
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Wellsville, N. Y.

The Otis Removable Bottom Hole Choke is fully patented.

T. N. St. Hill to Present Paper Before World Petroleum Congress

T. N. ST. HILL

T. N. St. Hill, president of Petroleum Rectifying Company of California, left Los Angeles on May 27th enroute to Paris to attend the World Petroleum Congress as a member of the committee of 18 American technologists who will have charge of that part of the program devoted to refining technology.

In addition to serving on the committee, St. Hill will present before the Congress a paper entitled "The Electrical Process For The Extraction of Salts From Refinery Charging Stocks." This paper was written jointly by St. Hill and H. C. Eddy, chief engineer of the Petroleum Rectifying Company of California.

Mr. St. Hill is being accompanied on the trip to Paris by Mrs. St. Hill. While there he will make a thorough investigation of the possibilities of adapting the Petreco Electromatic De-Salting Process to European refineries.

Trade Personals

H. JOHN EASTMAN, founder and president of the Eastman Oil Well Survey Company, accompanied by his daughter, Frances, left New York City June 1st for Paris, France, where Eastman will deliver a paper before the Second World Petroleum Congress. While in Europe Eastman will visit Germany, Roumania, England, Russia, and The Hague in the interest of his companies.

●

J. D. KELLY, who has been store manager for the Reed Roller Bit Company of Houston, Texas, at their Rocky Mountain headquarters in Casper, Wyoming, has been made field representative for the district. He succeeds M. R. KING, who has been transferred to Calgary, Alberta, as Canadian representative. M. B. MCELHANON has been transferred from Houston to Casper and made store manager.

●

E. C. DILGARDE recently was appointed Rocky Mountain district representative for the MacClatchie Manufacturing Company, Compton, California. His headquarters are in Casper, Wyoming.

●

J. T. SIMMONS, who has been stationed in Illinois for the Halliburton Oil Well Cementing Company, has been transferred to Casper, Wyoming, and will assist CLIFF HODGES in providing Halliburton service to operators in the Rocky Mountain area.

●

J. J. SUMMERSBY, assistant vice-president of Worthington Pump and Machinery Corporation, has been made general sales manager, it is announced.

●

H. O. K. MEISTER has been appointed general manager of the Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey. He succeeds the late H. J. FORSYTHE. Meister has been employed in various capacities in the Hyatt Division since 1914, being assistant general manager prior to his recent appointment.

●

CHAS. A. FLANNERY has been appointed sales manager of the Fabricated Plate Division of the Emsco Derrick and Equipment Company, Los Angeles, California.

●

J. P. BOORE recently was made assistant general sales manager of Babcock and Wilcox Tube Company, New York City. For several years he was vice-president of Summerill Tubing Company, and for 20 years prior to that was associated with the Pittsburgh Steel Company.

●

E. B. EVLETH has been appointed vice-president and general manager of the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company, Philadelphia, Pennsylvania. He succeeds WILLIAM J. HAJEK, who retired recently due to poor health. C. L. SAUNDERS, former regional sales manager, has been promoted to succeed Evleth as resident vice-president in charge of the Midwest Region for the Minneapolis-Honeywell Regulator Company.

●

R. I. MOORE, oil field salesman for the Allis-Chalmers Manufacturing Company, on June 1 was transferred from the Dallas, Texas, to the Tulsa, Oklahoma, office.

●

E. L. DECKER, of the Martin-Decker Corporation, Long Beach, California, is back in the United States following a six weeks' sales trip to South America. He traveled by air and visited the principal oil-producing countries.

Speed Pump Regulation Made Definite and Sure

CF
Compressor Regulator

EXCESS discharge pressure is relieved, discharge kept constant, and operation of the compressor at full speed made safe, by use of the C-F Compressor Regulator. As a close regulator of pressure on electric-driven pumps, it stands unrivalled. Gas, steam, air, water—in all such applications the C-F Compressor Regulator is thoroughly dependable. The lever type is here shown. A spring-loaded valve is also available and is equally sure in operation. Excess discharge pressure flows through without noticeable variation in suction line. Ask for Bulletin No. 130.

The
CHAPLIN-FULTON MFG. COMPANY
28-40 Penn Avenue Pittsburgh, Pa.

$70,000 Worth of Derricks Saved!
with a FRANKS PULLING UNIT

At the Panhandle Engineering Society meeting Feb. 24, 1937, an official of a large oil company reported the following: "We have been having great success with a Franks pulling machine—complete with pulling equipment, truck and telescoping mast—in pulling rods and tubing on our wells. The machine eliminates the necessity of derricks and permanent or portable masts over the wells. We are now taking down about 80 derricks which will not be replaced. This unit can be set up and rigged up within a few minutes, is cheaply operated, and can pull rods and tubing as well as they can be pulled with either a portable or permanent mast. The cost of this Franks unit is approximately $7,500 complete with mast, winch, truck, etc."

See pages 590 to 596

Franks units will give you the same service. Information and a demonstration gladly given.

FRANKS MFG. CORP.
WELL SERVICING AND DRILLING UNITS
P. O. Box 137 Whittier Station Tulsa, Oklahoma
Export Office: 149 Broadway, New York, N. Y.

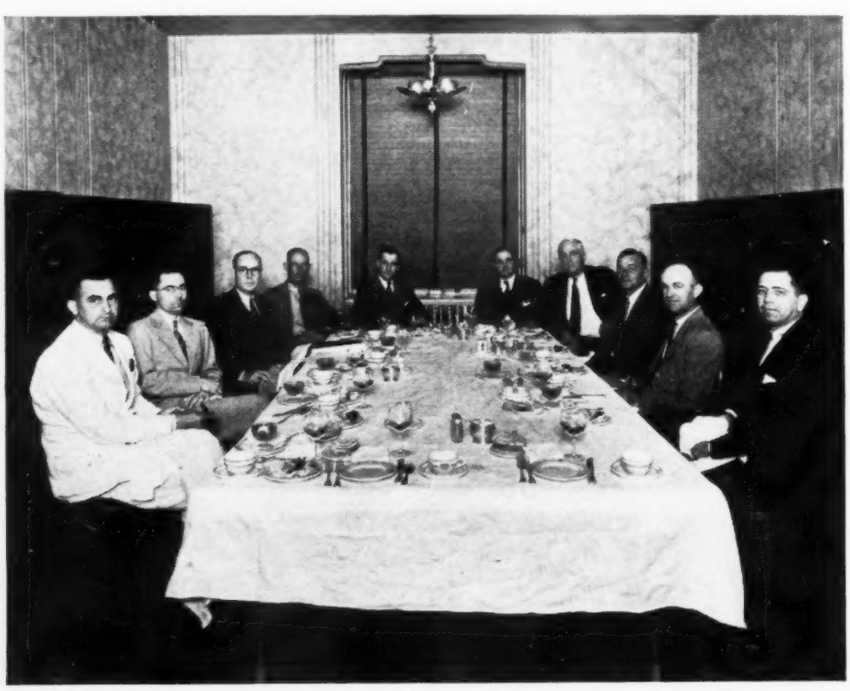
Houston Oil Show Increases Exhibit Space; Program Progressing

ALTHOUGH the new $1,337,000.00 Convention Hall is 40 percent larger and has more than 100,000 ft. of total floor area, it already has become necessary to obtain more space to display the equipment that will be exhibited at the Oil-World Exposition in Houston, Texas, from October 11 to 16, 1937. Following a meeting of the Board of Directors recently, John R. Suman, president of Oil-World Exposition, Inc., announced that it had been unanimously voted to increase the capacity of the Exposition in order to take care of the many applicants for space who were unable to obtain such space in the main exhibition building. To accomplish this purpose, a contract has been signed with the City of Houston for the rental of five vacant city blocks of park board property adjacent to the main exposition building.

More than 200 additional exhibiting spaces thus will be provided by the erection of one of the largest tents in the country. This tent is completely waterproof and will have a wooden floor, electric outlets, booth partitions, signs, water, gas, and all other facilities identical with those in the exposition building. Moreover, the main entrance to the Oil Show will be through this tent.

The additional area provided by the Exposition management also will offer an enlarged space for exhibits of large and heavy machinery for demonstration of equipment. This newly-acquired land is in addition to the originally-provided outdoor exhibiting space and thus will be able to provide parking facilities for the exhibitors.

Due to the widespread interest being taken in the Houston Show, the Board of Directors also voted an additional $15,000. A large portion of this appropriation will be spent in magazine, newspaper, poster, and direct mail advertising with an aim toward increasing the attendance from foreign countries as well as from all parts of the United States. The equipment displays now assured indicate that the coverage of tools and machinery for all branches of the petroleum industry will be most complete; and that equipment of the most modern design will be on display for those interested in drilling, production, refining, natural gas manufacture, pipe line, and all forms of transportation and in efficient marketing methods.



The Executive Committee of the Oil-World Exposition. Left to right: Ed Lenzner, general manager; Fred Allen, auditor; Ray L. Dudley, secretary and treasurer; Frank Carothers, member executive committee; John R. Suman, president; George A. Hill, Jr., vice-president; W. L. Childs, vice-president; S. P. Brown, member executive committee; Chase Sutton, executive vice-president; Wallace Wilson, vice-president

●

Directional Drilling Program

The increased interest shown in directional drilling and the great value of this technique in meeting many problems have led the Oil-World Exposition to plan a comprehensive program on this subject. The directional drilling committee headed by G. B. Corless, has decided to have reviewed the experiences obtained by those who have drilled wells directionally, and to have discussed the mechanics of controlled drilling and the various methods of surveying wells so that practical field men will have a better understanding of the problems involved.

The program is as follows:

1. "Historical Review of Production Experience on Deviated Wells" by H. John Eastman.
2. "Technique of Controlled Drilling" by Douglas Ragland, Humble Oil and Refining Company.
3. "Well Surveying Methods."
   (a) "Oriented Surveys" by Lane-Wells Company.
   (b) "Gyroscopic Surveys" by R. S. Hyer.
   (c) "Magnetic Surveys" by Eastman Oil Well Survey Company.
4. "Geological Application of Oriented Coring" sponsored by A. B. Patterson, The Texas Company.

The committee, composed of G. B. Corless, chairman; Ed Lenzner, assistant chairman; Alexander Anderson, Alexander Anderson, Inc.; H. John Eastman, Eastman Oil Well Survey Company; R. S. Hyer, Sperry-Sun Well Surveying Co.; A. B. Patterson, The Texas Company; M. L. Cashion, Gulf Production Company; D. B. Collins, Shell Petroleum Corporation, is conferring with the leading engineers and superintendents and will provide a very interesting meeting in the convention hall of the exposition building on October 12, Tuesday, from 2 p. m. to 4 p. m. This particular program will be of great interest to many engineers and superintendents and oil men from all parts of the country and should be of particular value to foreign visitors by giving them complete data on this important subject, which has been so highly developed in the United States.

New Equipment Patents and Inventions

LESTER B. CLARK

In order to acquaint the industry and the manufacturers of equipment with the new tools and machinery being developed for field and plant use, a display of new inventions and patented ideas has been arranged. A section has been set aside for the showing of actual tools, working models, patterns, and drawings. Anyone having a tool or invention relating to the oil industry is invited to be present and display his proposed designs. Space will be provided without charge if the equipment has not been put on the market or manufactured by any manufacturing concern.

During past years, the oil exposition at Houston has been instrumental in assisting numerous inventors, who have displayed their ideas, in making connections with various concerns to manufacture their new inventions; and at the same time it has helped the industry considerably by presenting new products and new equipment.

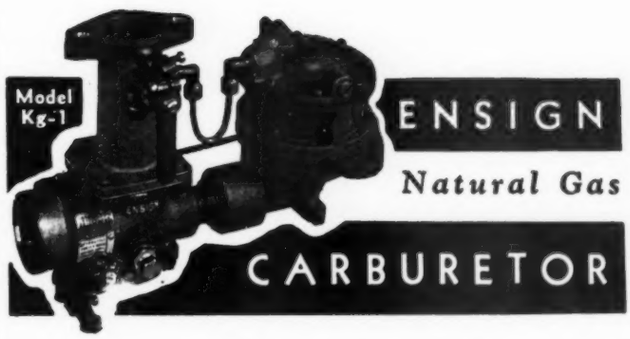
This is an exceptional opportunity for the inventor who might otherwise not be in a position to contact someone able to finance or manufacture his invention.

Invitations have been sent out to all patent attorneys throughout the country to advise their clients of this opportunity. The New Patents and Inventions Committee, of which Lester B. Clark, patent attorney, is chairman, and E. G. Lenzner, assistant chairman, is arranging for an evening meeting where the inventors can present talks on patents. At this meeting some of those who have new tools that are ready for manufacture will be introduced and the operation of their inventions to meet practical conditions demonstrated.

Colonel Thompson Official Delegate to World Petroleum Congress

ERNEST O. THOMPSON

Colonel Ernest O. Thompson, Railroad Commissioner of Texas, sailed on June 2 for the World Petroleum Congress in Paris, as official delegate to represent the Oil-World Exposition. Colonel Thompson is appearing before the World Petroleum Congress to present technical papers pertaining to the petroleum industry. He also will present to the many thousands of foreign oil men present at the Congress an invitation to attend the Oil-World Exposition. Numerous foreign oil men already have written for hotel reservations, tickets, badges, and information, and it is anticipated that an exceptionally large number will attend.



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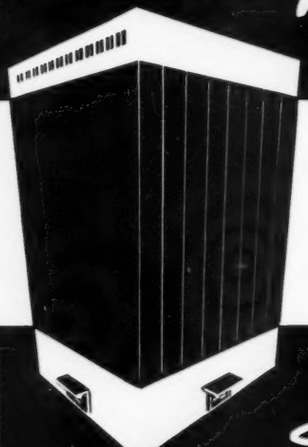

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TRADE LITERATURE

WILSON-SNYDER MANUFACTURING CORPORATION, Pittsburgh, Pennsylvania, recently issued three bulletins descriptive of several items of their equipment. Bulletin W-72-J covers the company's boilerfeed pump designed for 350-lb. working pressure on the steam end and 1000-lb. working pressure on the fluid end. Bulletin No. W-159 describes the Super Wilson-Snyder Steam Slush Pump. Bulletin No. W-104-B concerns the Wilson-Snyder No. 16 Steam Slush Pump. Any or all of these bulletins may be obtained free upon request.

●

Oil Well Supply Company, Dallas, Texas, has published Bulletin No. 169, descriptive of its 10-in. by 4½-in. by 10-in. boilerfeed pump, a heavy-duty oil-country pump having 1000-lb. working pressure on the fluid end. Copies will be mailed free upon request.

●

Monel wire screen and filter cloth is the subject of Bulletin H-3 issued by The International Nickel Company, Inc., New York City. Uses, specifications, etc., are discussed, and the publication is well illustrated throughout.

●

FOSTER WHEELER CORPORATION, 165 Broadway, New York City, has issued a bulletin describing the new type "S" stainless steel bellows expansion joint that was announced to the public at the New York Power Show last December. This bulletin describes briefly the forms in which the joint is regularly produced for pressures up to and including 150 lb. per sq. inch. By the use of suitable flanges these same joints are good for an operating pressure of 200 lb. per sq. inch. For high pressure work a modification of the bellows is employed and the joints are then suitable for 300-lb. working pressure. In all cases the service includes operating temperatures up to 750 deg. fahrenheit.

●

THE DIESEL ENGINE as a solution to many pumping problems is the subject of the booklet issued recently by the Caterpillar Tractor Company, Peoria, Illinois. The booklet deals briefly with pumping problems the world over and gives illustrations of Diesel engine performance both in the United States and abroad. The booklet is called "Solving Pumping Problems With 'Caterpillar' Diesel Engines" and is Form 4148. It may be obtained free of charge by writing Caterpillar Tractor Company.

●

TWELVE of the modern types of industrial furnaces for which the new JM-20 Insulating Brick has been developed are illustrated in a new piece of literature entitled, "Lower Furnace Operating Costs With Johns-Manville JM-20 Insulating Brick." These furnace drawings show clearly the application of this new insulating brick to each of the 12 different types. One of the most useful features of this literature is a table giving the heat losses transmitted through fire brick walls bare and through fire brick walls insulated with JM-20 Brick. Copies are available free upon request to Johns-Manville, 22 East 40th Street, New York City.

●

A COMPACT presentation of the Worthington line of vertical single-cylinder single-stage air-cooled and water-cooled compressors is offered in an illustrated eight-page bulletin. Sectional views showing important features of construction,

detailed specifications of the feather-type valves and other principal elements, rating tables, and dimension tables, are included. Bare compressors, and base-mounted units with motor and V-belt drive, are covered in the tables. Ask for Bulletin L-621-B5. Address Worthington Pump and Machinery Corporation, Harrison, New Jersey.

●

THE GENERAL ELECTRIC COMPANY, Schenectady, New York, has issued a group of bulletins describing certain products manufactured by them, entitled as follows: "Pressure and Vacuum Switches, CR2927, Diaphragm Type"; "Surface Air Coolers for Turbine-Generators"; "Lightning Protective Equipment for A-c. Rotating Machines"; "Low-Speed Synchronous Motors '6000 Series' "; "The Two-Element Single-Disk Watthour Meters"; "Fractional Horsepower Motors." Any or all of these bulletins will be sent free upon request.

●

THE CHAPLIN-FULTON MANUFACTURING COMPANY, 28-40 Penn Avenue, Pittsburgh, Pennsylvania, is mailing free to those asking for it a pamphlet describing their recently-developed high-pressure soft seat inside valve for regulators, as well as their "V-Port" inside valves.

●

BEAVER PIPE TOOLS, INC., Warren, Ohio, are distributing a new bulletin in which is fully described the Beaver Model-A portable unit for cutting and threading pipe and bolts. The publication is profusely illustrated, and copies are being sent free upon request.

●

"THE WELDING OF ENDURO STAINLESS STEEL" is a new 20-page booklet published by Republic Steel Corporation, Cleveland, Ohio. Profusely illustrated, the booklet describes in detail the proper methods for welding stainless steel by electric arc, gas, seam, spot, projection, and atomic hydrogen methods. Also included is information on brazing and silver soldering. An interesting feature is a table showing in condensed form the physical, electrical and mechanical properties of 13 of the more important types of Enduro Stainless Steel, contrasted with similar properties of a carbon steel, S.A.E. 1020. Copies of the booklet, Form Adv. 180, are available upon request.

●

INGERSOLL-RAND COMPANY, 11 Broadway, New York, N. Y., has issued a new catalog describing its Cameron Motor-pumps. These pumps are compact machines combining electric motor and centrifugal pumps in a single unit. Capacities range from 5 to 1000 gal. per min. for heads to 500 feet. Motor sizes range from ¼ to 40 horsepower.

●

AN INGENIOUS slide-rule indicator for use in selecting the proper instruments for any application, whether central stations, industrial plants, or transportation industry, has been announced by the Westinghouse Electric and Manufacturing Company. Called the Instrulector, this slide-rule shows at a glance what instruments to use, their range, approximate price, size, descriptive literature available. The Instrulector is available from the nearest district office or direct from the Advertising Department, 7-N, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

United Supply and Manufacturing Company Opens Dallas Office

The United Supply and Manufacturing Company, Tulsa, Oklahoma, has opened a branch office at 1412 Magnolia Building, Dallas, Texas. Frank Wood is in charge.

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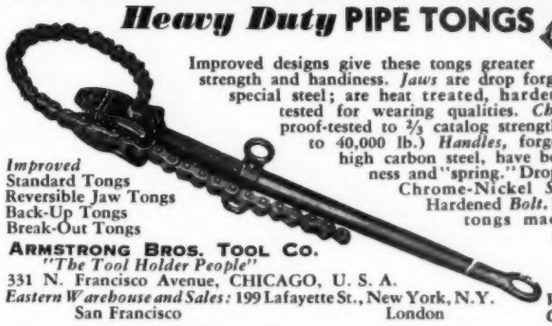

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Begins on Page 123 of This Issue

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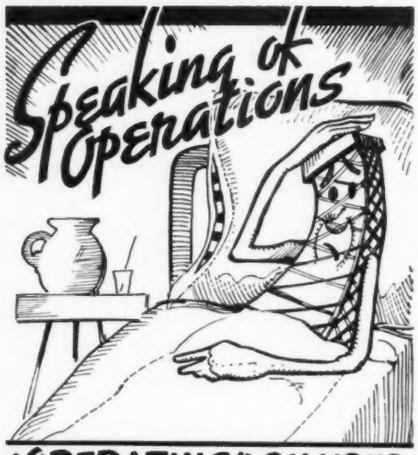

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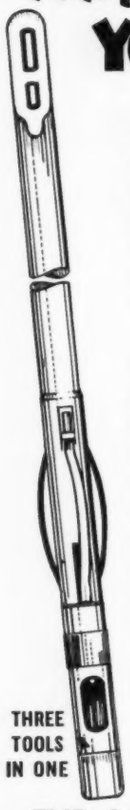

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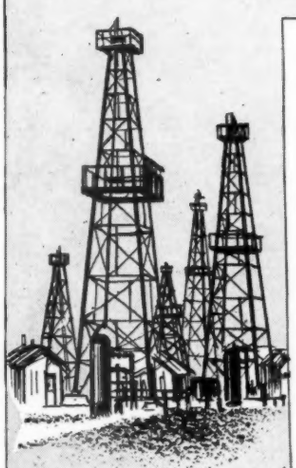
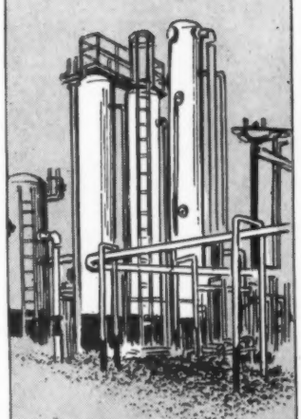
A DAILY REFERENCE FOR OPERATING MEN





INSTALLMENT NO. 1

THE tables on the following pages are the first of a continuous series designed to save time and effort for the technician, and to assist the practical field or plant worker to solve problems commonly encountered in routine work. They are not intended nor expected to supplant technical training and make every man his own designer. Most of the tables can be understood and applied by anyone acquainted with the simple fundamentals of mathematics.

For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several natural divisions, as illustrated by the following outline:

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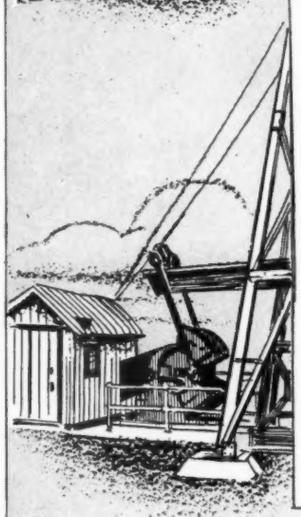
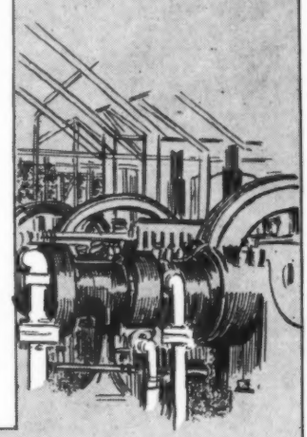
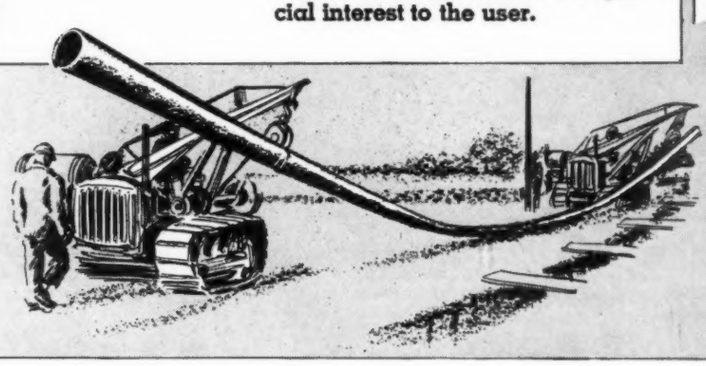
Nos. P400-P499—Drilling
Nos. P500-P599—Production
Nos. P600-P699—Transportation and Storage (includes Pipe Line)
Nos. P700-P799—Refining, including
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user.







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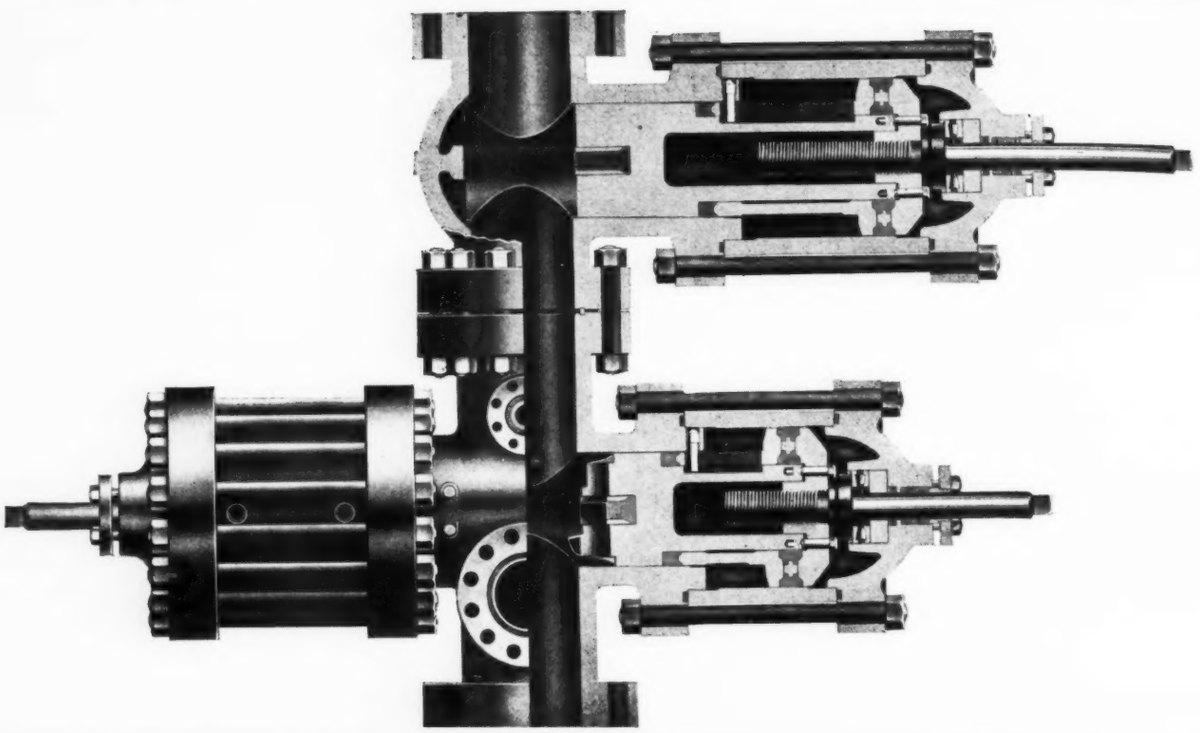
HYDROSTATIC PRESSURE IN LB. PER SQ. IN. OF FLUID COLUMNS OF DIFFERENT DENSITIES

Length of column, ft.	Density of fluid, lb. per gal.												
	8½	9	9½	10	10½	11	12	13	14	15	16	17	18
100	44	47	49	52	55	57	62	68	73	78	83	88	94
200	88	94	99	104	109	114	125	135	145	156	166	177	187
300	132	140	148	156	164	171	187	203	218	234	249	265	281
400	177	187	197	208	218	229	249	270	291	312	332	353	374
500	221	234	247	260	273	286	312	338	364	390	416	442	468
600	265	281	296	312	327	343	374	405	436	468	499	530	561
700	309	327	345	364	382	400	436	473	509	545	582	618	655
800	353	374	395	416	436	457	499	540	582	623	665	706	748
900	397	421	444	468	491	514	561	608	655	701	748	795	842
1,000	442	468	494	519	545	571	623	675	727	779	831	883	935
1,100	486	514	543	571	600	629	686	743	800	857	914	971	1,029
1,200	530	561	592	623	655	686	748	810	873	935	997	1,060	1,122
1,300	574	608	642	675	709	743	810	878	945	1,013	1,081	1,148	1,216
1,400	618	655	691	727	764	800	873	945	1,018	1,091	1,164	1,236	1,309
1,500	662	701	740	779	818	857	935	1,013	1,091	1,169	1,247	1,325	1,403
1,600	706	748	790	831	873	914	997	1,081	1,164	1,247	1,330	1,413	1,496
1,700	751	795	839	883	927	971	1,060	1,148	1,236	1,325	1,413	1,501	1,590
1,800	795	842	888	935	982	1,029	1,122	1,216	1,309	1,403	1,496	1,590	1,683
1,900	839	888	938	987	1,036	1,086	1,184	1,283	1,382	1,481	1,579	1,678	1,777
2,000	883	935	987	1,039	1,091	1,143	1,247	1,351	1,455	1,558	1,662	1,766	1,870
2,100	927	982	1,036	1,091	1,145	1,200	1,309	1,418	1,527	1,636	1,745	1,855	1,964
2,200	971	1,029	1,086	1,143	1,200	1,257	1,371	1,486	1,600	1,714	1,829	1,943	2,057
2,300	1,016	1,075	1,135	1,195	1,255	1,314	1,434	1,553	1,673	1,792	1,912	2,031	2,151
2,400	1,060	1,122	1,184	1,247	1,309	1,371	1,496	1,621	1,745	1,870	1,995	2,119	2,244
2,500	1,104	1,169	1,234	1,299	1,364	1,429	1,558	1,688	1,818	1,948	2,078	2,208	2,338
2,600	1,148	1,216	1,283	1,351	1,418	1,486	1,621	1,756	1,891	2,026	2,161	2,296	2,431
2,700	1,192	1,262	1,332	1,403	1,473	1,543	1,683	1,823	1,964	2,104	2,244	2,384	2,525
2,800	1,236	1,309	1,382	1,455	1,527	1,600	1,745	1,891	2,036	2,182	2,327	2,473	2,618
2,900	1,281	1,356	1,431	1,506	1,582	1,657	1,808	1,958	2,109	2,260	2,410	2,561	2,712
3,000	1,325	1,403	1,481	1,558	1,636	1,714	1,870	2,026	2,182	2,338	2,494	2,649	2,805
3,100	1,369	1,449	1,530	1,610	1,691	1,771	1,932	2,094	2,255	2,416	2,577	2,738	2,899
3,200	1,413	1,496	1,579	1,662	1,745	1,829	1,995	2,161	2,327	2,494	2,660	2,826	2,992
3,300	1,457	1,543	1,629	1,714	1,800	1,886	2,057	2,229	2,400	2,571	2,743	2,914	3,086
3,400	1,501	1,590	1,678	1,766	1,855	1,943	2,119	2,296	2,473	2,649	2,826	3,003	3,179
3,500	1,545	1,636	1,727	1,818	1,909	2,000	2,182	2,364	2,545	2,727	2,909	3,091	3,273
3,600	1,590	1,683	1,777	1,870	1,964	2,057	2,244	2,431	2,618	2,805	2,992	3,179	3,366
3,700	1,634	1,730	1,826	1,922	2,018	2,114	2,306	2,499	2,691	2,883	3,075	3,268	3,460
3,800	1,678	1,777	1,875	1,974	2,073	2,171	2,369	2,566	2,764	2,961	3,158	3,356	3,553
3,900	1,722	1,823	1,925	2,026	2,127	2,229	2,431	2,634	2,836	3,039	3,242	3,444	3,647
4,000	1,766	1,870	1,974	2,078	2,182	2,286	2,494	2,701	2,909	3,117	3,325	3,532	3,740
4,100	1,810	1,917	2,023	2,130	2,236	2,343	2,556	2,769	2,982	3,195	3,408	3,621	3,834
4,200	1,855	1,964	2,073	2,182	2,291	2,400	2,618	2,836	3,055	3,273	3,491	3,709	3,927
4,300	1,899	2,010	2,122	2,234	2,345	2,457	2,681	2,904	3,127	3,351	3,574	3,797	4,021
4,400	1,943	2,057	2,171	2,286	2,400	2,514	2,743	2,971	3,200	3,429	3,657	3,886	4,114
4,500	1,987	2,104	2,221	2,338	2,455	2,571	2,805	3,039	3,273	3,506	3,740	3,974	4,208
4,600	2,031	2,151	2,270	2,390	2,509	2,629	2,868	3,106	3,345	3,584	3,823	4,062	4,301
4,700	2,075	2,197	2,319	2,442	2,564	2,686	2,930	3,174	3,418	3,662	3,906	4,151	4,395
4,800	2,119	2,244	2,369	2,494	2,618	2,743	2,992	3,242	3,491	3,740	3,990	4,239	4,488
4,900	2,164	2,291	2,418	2,545	2,673	2,800	3,055	3,309	3,564	3,818	4,073	4,327	4,582
5,000	2,208	2,338	2,468	2,597	2,727	2,857	3,117	3,377	3,636	3,896	4,156	4,416	4,675
6,000	2,649	2,805	2,961	3,117	3,273	3,429	3,740	4,052	4,364	4,675	4,987	5,299	5,610
7,000	3,091	3,273	3,455	3,636	3,818	4,000	4,364	4,727	5,091	5,455	5,818	6,182	6,545
8,000	3,532	3,740	3,948	4,156	4,364	4,571	4,987	5,403	5,818	6,234	6,649	7,065	7,481
9,000	3,974	4,208	4,442	4,675	4,909	5,143	5,610	6,078	6,545	7,013	7,481	7,948	8,416
10,000	4,416	4,675	4,935	5,195	5,455	5,714	6,234	6,753	7,273	7,792	8,312	8,831	9,351
11,000	4,857	5,143	5,429	5,714	6,000	6,286	6,857	7,429	8,000	8,571	9,143	9,714	10,286
12,000	5,299	5,610	5,922	6,234	6,545	6,857	7,481	8,104	8,727	9,351	9,974	10,597	11,221

WHEN DRILLING FLUID WON'T



CAMERON CONTROL UNITS WILL!

CIRCULATING FLUID of the proper weight, viscosity, gell strength, et cetera, is, of course, the operator's first line of defense against unruly well pressures.

But, when drilling fluids *won't* hold well pressures, Cameron drilling control hook-ups *will*. These fast, positive and completely dependable full pressure-operated units provide safe, sure control from a remote control point.

The 10¾", 6,000-pound test hook-up shown above, for instance, was designed to control swiftly and certainly any pressures which might prove impossible to hold with drilling mud. The particular application of this hook-up is on intermediate casing strings on deep wells where extremely high bottom hole pressures may be anticipated. It consists of a 10¾" Type SDA Full Pressure Operated Blowout Preventer; a 10¾" Type DV Full Pressure Operated Master Gate Valve; and (not shown) a 7" Type DV Full Pressure Operated Flowline Gate Valve. Three independent four-way control valves, located on the derrick floor within easy reach of the driller, give him instant control of each of these units.

Full and complete details of Cameron 6,000 pound test drilling control hook-ups, in sizes for intermediate casing strings or oil strings, will gladly be forwarded on request.

CAMERON IRON WORKS, INC.

711 MILBY STREET, HOUSTON, TEXAS

Export Office: 74 Trinity Place, New York, New York

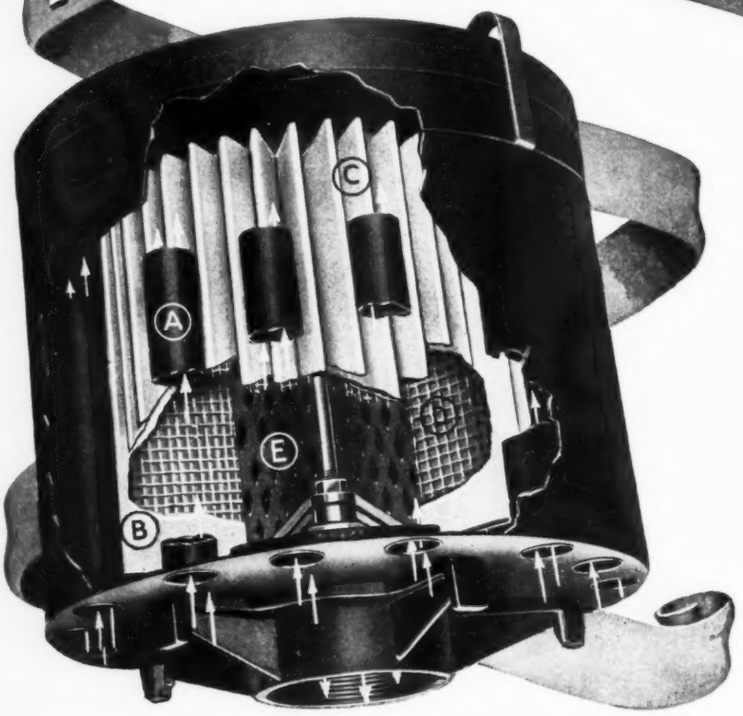
MIDLAND: W. P. (Red) Knight
CORPUS CHRISTI: J. M. (Red) Teague
LOUISIANA: Pelican Well Tool and Supply Company
OKLAHOMA AND KANSAS: Carson Machine & Supply Co.
MEXICO: J. W. Allen, Apdo. 542, Tampico, Tamps.
SOUTH AMERICA: G. N. Stewart

CORRECTIONS TO CONVERT UNCORRECTED VAPOR PRESSURES TO REID VAPOR PRESSURES

Initial air temperature, deg. fahr.	Corrections in lb. per sq. in. for various temperatures as calculated for normal barometric pressures of:				
	760 mm.	745 mm.	700 mm.	650 mm.	600 mm.
32	—2.9	—2.9	—2.7	—2.6	—2.5
34	—2.8	—2.8	—2.6	—2.5	—2.4
36	—2.8	—2.7	—2.5	—2.4	—2.3
38	—2.7	—2.7	—2.5	—2.3	—2.2
40	—2.6	—2.6	—2.4	—2.3	—2.2
42	—2.5	—2.5	—2.4	—2.2	—2.1
44	—2.5	—2.5	—2.3	—2.2	—2.1
46	—2.4	—2.4	—2.3	—2.1	—2.0
48	—2.3	—2.3	—2.2	—2.1	—2.0
50	—2.2	—2.2	—2.1	—2.0	—1.9
52	—2.1	—2.1	—2.0	—1.9	—1.9
54	—2.0	—2.0	—1.9	—1.8	—1.8
56	—2.0	—2.0	—1.9	—1.7	—1.7
58	—1.9	—1.9	—1.8	—1.7	—1.7
60	—1.8	—1.8	—1.7	—1.6	—1.6
62	—1.8	—1.8	—1.7	—1.6	—1.6
64	—1.7	—1.7	—1.6	—1.5	—1.5
66	—1.6	—1.6	—1.5	—1.4	—1.4
68	—1.5	—1.5	—1.4	—1.3	—1.3
70	—1.4	—1.4	—1.3	—1.3	—1.2
72	—1.3	—1.3	—1.3	—1.2	—1.2
74	—1.3	—1.3	—1.2	—1.2	—1.1
76	—1.2	—1.2	—1.1	—1.1	—1.1
78	—1.1	—1.1	—1.1	—1.0	—1.0
80	—1.0	—1.0	—1.0	—0.9	—0.9
82	—0.9	—0.9	—0.9	—0.9	—0.8
84	—0.8	—0.8	—0.8	—0.8	—0.7
86	—0.7	—0.7	—0.7	—0.7	—0.6
88	—0.6	—0.6	—0.6	—0.6	—0.5
90	—0.5	—0.5	—0.5	—0.5	—0.5
92	—0.4	—0.4	—0.4	—0.4	—0.4
94	—0.3	—0.3	—0.3	—0.3	—0.3
96	—0.2	—0.2	—0.2	—0.2	—0.2
98	—0.1	—0.1	—0.1	—0.1	—0.1
100	—0.0	—0.0	—0.0	—0.0	—0.0
102	+0.1	+0.1	+0.1	+0.1	+0.1
104	+0.2	+0.2	+0.2	+0.2	+0.2
106	+0.3	+0.3	+0.3	+0.3	+0.3
108	+0.5	+0.5	+0.4	+0.4	+0.4
110	+0.6	+0.6	+0.5	+0.5	+0.5

From Natural Gasoline Supply Men's Association 1937 Handbook.

THIS AIR FILTER SILENCES!



SAVES MONEY
SAVES SPACE
SAVES WEIGHT

WHY buy an air filter, and then have to install a silencer later at extra cost and trouble? Get a Protectomotor Model DS — not only the *finest air filter ever made* but an effective *silencer* of intake noises as well. Noisy internal combustion engines and compressors are extremely nerve wracking. The Protectomotor DS silences them and gives you trouble free operation also. A size is available to fit all capacities from the smallest to the largest. Prices are reasonable—little more than the cost of an air filter alone. Write today for latest catalog and folder. Catalog describes full line of filters for ventilation and engine protection.

PROTECTOMOTOR MODEL DS SILENCER-FILTER...

A. Cylindrical rectifying chamber. (A series).
B. Dry Feltex Filtering Medium.
C. Circular Fin Construction.
D. Rigid, Galvanized Mesh Frame.
E. Reinforcing Tube.

HERE'S WHAT A USER SAYS:

Letter dated January 23, 1937, from the president of the Armstrong Rubber Co., of West Haven, Conn. He writes: *"We installed an air compressor which developed a noisy intake . . . this became intolerable to neighbors . . . in night operation. We then installed your Silencer type of filter . . . the improvement was instant, and we think, remarkable, enabling us to work nights without complaint."*

(Signed) J. A. WALSH, *President.*

PROTECTOMOTOR
REG. U.S. PAT. OFF.
99 9/10 Per Cent EFFICIENT
AIR FILTERS

STAYNEW FILTER CORP.
2 Leighton Avenue, Rochester, N. Y.

SOLVES NOISE *AND* DUST PROBLEMS WITH *ONE* FILTER

HORIZONTAL AND VERTICAL DISPLACEMENT[1] OF CROOKED HOLES, FT.

Measured depth, ft.	Deviation, degrees from vertical																					
	1		2		3		4		5		6		7		8		9		10		11		12	
	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V
500	9	.1	17	.3	26	.7	35	1.2	44	1.9	52	2.7	61	3.7	70	4.9	78	6.2	87	7.6	95	9	104	11
750	13	.1	26	.5	39	1.0	52	1.8	65	2.9	78	4.1	91	5.6	104	7.3	117	9.2	130	11	143	14	156	16
1,000	17	.2	35	.6	52	1.4	70	2.4	87	3.8	105	5.5	122	7.4	139	9.7	156	12	174	15	191	18	208	22
1,200	21	.2	42	.7	63	1.6	84	2.9	105	4.6	125	6.6	146	8.9	167	12	188	15	208	18	229	22	249	26
1,400	24	.2	49	.8	73	1.9	98	3.4	122	5.3	146	7.7	171	10	195	14	219	17	243	21	267	26	291	31
1,600	28	.2	56	1.0	84	2.2	112	3.9	139	6.1	167	8.8	195	12	223	16	250	20	278	24	305	29	333	35
1,800	31	.3	63	1.1	94	2.5	126	4.4	157	6.9	188	9.9	219	13	251	18	282	22	313	27	343	33	374	39
2,000	35	.3	70	1.2	105	2.7	140	4.9	174	7.6	209	11	244	15	278	19	313	25	347	30	382	37	416	44
2,200	38	.3	77	1.3	115	3.0	153	5.4	192	8.4	230	12	268	16	306	21	344	27	382	33	420	40	457	48
2,400	42	.4	84	1.5	126	3.3	167	5.9	209	9.1	251	13	292	18	334	23	375	30	417	36	458	44	499	52
2,600	45	.4	91	1.6	136	3.6	181	6.3	227	9.9	272	14	317	19	362	25	407	32	451	39	496	48	541	57
2,800	49	.4	98	1.7	147	3.8	195	6.8	244	11	293	15	341	21	390	27	438	34	486	43	534	51	582	61
3,000	52	.4	105	1.8	157	4.1	209	7.3	261	11	314	16	366	22	418	29	469	37	521	46	572	55	624	66
3,200	56	.5	112	2.0	167	4.4	223	7.8	279	12	334	18	390	24	445	31	501	39	556	49	611	59	665	70
3,400	59	.5	119	2.1	178	4.7	237	8.3	296	13	355	19	414	25	473	33	532	42	590	52	649	62	707	74
3,600	63	.5	126	2.2	188	4.9	251	8.8	314	14	376	20	439	27	501	35	563	44	625	55	687	66	748	79
3,800	66	.6	133	2.3	199	5.2	265	9.3	331	14	397	21	463	28	529	37	594	47	660	58	725	70	790	83
4,000	70	.6	140	2.4	209	5.5	279	9.8	349	15	418	22	487	30	557	39	626	49	695	61	763	73	832	87
4,200	73	.6	147	2.6	220	5.8	293	10	366	16	439	23	512	31	585	41	657	52	729	64	801	77	873	92
4,400	77	.7	154	2.7	230	6.0	307	11	384	17	460	24	536	33	612	43	688	54	764	67	840	81	915	96
4,600	80	.7	161	2.8	241	6.3	321	11	401	18	481	25	561	34	640	45	720	57	799	70	878	85	956	101
4,800	84	.7	168	2.9	251	6.6	335	12	418	18	502	26	585	36	668	47	751	59	834	73	916	88	998	105
5,000	87	.8	175	3.0	262	6.9	349	12	436	19	523	27	609	37	696	49	782	62	868	76	954	92	1,040	109
5,200	91	.8	181	3.2	272	7.1	363	13	453	20	544	28	634	39	724	51	813	64	903	79	992	96	1,081	114
5,400	94	.8	188	3.3	283	7.4	377	13	471	21	564	30	658	40	752	53	845	66	938	82	1,030	99	1,123	118
5,600	98	.8	195	3.4	293	7.7	391	14	488	21	585	31	682	42	779	54	876	69	972	85	1,069	103	1,164	122
5,800	101	.9	202	3.5	304	8.0	405	14	506	22	606	32	707	43	807	56	907	71	1,007	88	1,107	107	1,206	127
6,000	105	.9	209	3.7	314	8.2	419	15	523	23	627	33	731	45	835	58	939	74	1,042	91	1,145	110	1,247	131
6,500	113	1.0	227	4.0	340	8.9	453	16	567	25	679	36	792	48	905	63	1,017	80	1,129	99	1,240	119	1,351	142
7,000	122	1.1	244	4.3	366	9.6	488	17	610	27	732	38	853	52	974	68	1,095	86	1,216	106	1,336	129	1,455	153
7,500	131	1.1	262	4.6	393	10	523	18	654	29	784	41	914	56	1,044	73	1,173	92	1,302	114	1,431	138	1,559	164
8,000	140	1.2	279	4.9	419	11	558	20	697	30	836	44	975	60	1,113	78	1,251	98	1,389	122	1,526	147	1,663	175
8,500	148	1.3	297	5.2	445	12	593	21	741	32	889	47	1,036	63	1,183	83	1,330	105	1,476	129	1,622	156	1,767	186
9,000	157	1.4	314	5.5	471	12	628	22	784	34	941	49	1,097	67	1,253	88	1,408	111	1,563	137	1,717	165	1,871	197
9,500	166	1.4	332	5.8	497	13	663	23	828	36	993	52	1,158	71	1,322	92	1,486	117	1,650	144	1,813	175	1,975	208
10,000	175	1.5	349	6.1	523	14	698	24	872	38	1,045	55	1,219	74	1,392	97	1,564	123	1,736	152	1,908	184	2,079	218
10,500	183	1.6	366	6.4	550	14	732	26	915	40	1,098	58	1,280	78	1,461	102	1,643	129	1,823	160	2,004	193	2,183	229
11,000	192	1.6	384	6.7	576	15	767	27	959	42	1,150	60	1,341	82	1,531	107	1,721	135	1,910	167	2,099	202	2,287	240
11,500	201	1.7	401	7.0	602	16	802	28	1,002	44	1,202	63	1,402	86	1,600	112	1,799	142	1,997	175	2,194	211	2,391	251
12,000	209	1.8	419	7.3	628	16	837	29	1,046	46	1,254	66	1,462	89	1,670	117	1,877	148	2,084	182	2,290	220	2,495	262
12,500	218	1.9	436	7.6	654	17	872	30	1,090	48	1,307	68	1,523	93	1,740	122	1,955	154	2,171	190	2,385	230	2,599	273

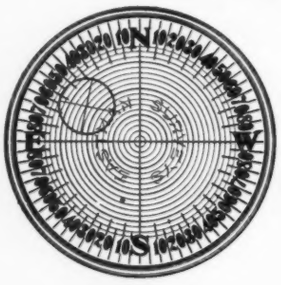
[1]Assuming uniform deviation all in one direction. The figures for horizontal displacement are therefore a maximum limit.

Horizontal and vertical displacement for intermediate depths or horizontal displacement for intermediate angles may be determined by interpolation. Vertical displacement for angles not included in the table may be determined by multiplying the measured depth by 1 minus the cosine of the angle. $V = D(1 - \cos\theta)$. The vertical depth of crooked holes is always less than the measured depth.

READ THE FACTS!

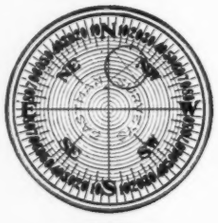
DEPENDABLE *Eastman*

SURVEY INSTRUMENTS:



SINGLE SHOT SURVEY INSTRUMENT

Run in the open hole on sand line or drill pipe, this instrument makes a photographic record of the degrees of inclination and direction of deviation. It makes possible a continuous plat of deviation while drilling progresses. It can be easily operated by drilling crews. It has proven to be the most dependable and conveniently operated instrument available. It is leased at a reasonable monthly rate, being serviced and checked regularly at no extra cost. Actual size photographic record shown at left.

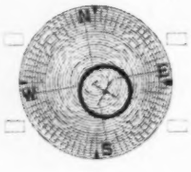


INSIDE SINGLE SHOT SURVEY INSTRUMENT

This instrument is run through drill pipe while retractable wire line coring equipment is being used. Because it eliminates the pulling of drill pipe, it speeds up directional surveying and saves time and wear on the rig. It operates identically as does the open hole type Single Shot, a non-magnetic barrel extending through the hole in the bit and shoulders in the drill collar, and provides the same proven accuracy and convenience in operation. Available on monthly rental basis, being serviced and checked regularly at no additional cost. Actual size photographic record shown at left.

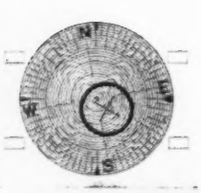
DRIFT INDICATOR

Run inside of drill pipe, either on a wire line or go-devil, this instrument makes a quick, accurate, dependable record of inclination only. No confusing duplication of record possible. The barrel and instrument are specially constructed to withstand abuse and to insure satisfactory service. It provides a permanent, easily-read record, shown actual size at left. Any drilling crew can run it easily, conveniently. Rented on monthly basis and checked and serviced at no additional cost.



MULTIPLE SHOT SURVEY SERVICE

The Multiple Shot Survey Instrument, operated by Eastman Engineers, is available anywhere at any time. It can be run in any size hole . . . to any depth. This instrument makes a continuous survey record as it is lowered into the hole on the drill pipe. Only one round trip is necessary. Results of the survey are available within six hours after the instrument reaches the surface. Special orienting equipment eliminates human error. This service is available at a reasonable per foot rate.



For Further Information, Write:

Eastman OIL WELL SURVEY CO.

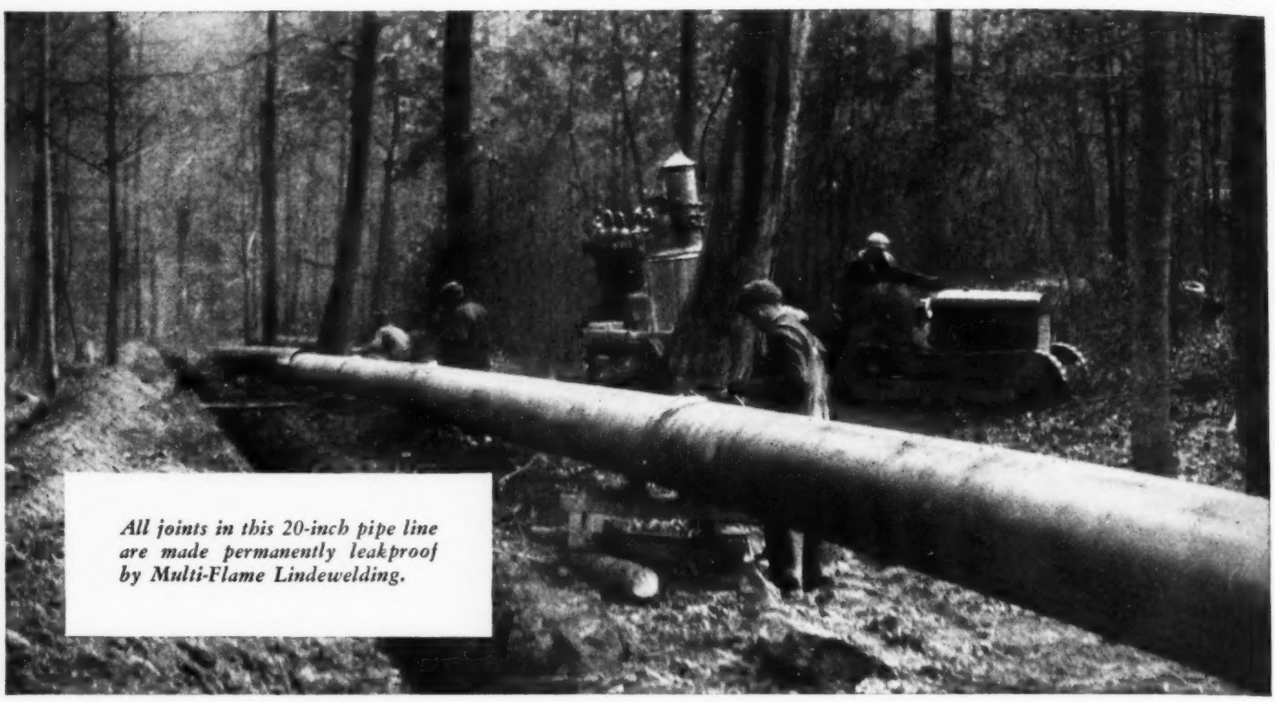
General Offices: DALLAS, TEXAS

LONG BEACH HOUSTON OKLAHOMA CITY

STORAGE CAPACITY OF PIPE LINES, BARRELS

Length of line	Nominal diameter of line, inches								
	2	2½	3	4	5	6	8	10	12
10 feet	.042	.059	.091	.157	.247	.357	.633	1.01	1.42
20	.083	.118	.183	.315	.495	.715	1.27	2.02	2.84
30	.125	.178	.274	.472	.742	1.07	1.90	3.03	4.26
40	.166	.237	.366	.630	.990	1.43	2.53	4.04	5.68
50	.208	.296	.457	.787	1.24	1.79	3.16	5.05	7.10
60	.249	.355	.549	.945	1.48	2.14	3.80	6.05	8.52
70	.291	.415	.640	1.10	1.73	2.50	4.43	7.06	9.94
80	.332	.474	.732	1.26	1.98	2.86	5.06	8.07	11.36
90	.374	.533	.823	1.42	2.23	3.22	5.70	9.08	12.78
100	.415	.592	.914	1.57	2.47	3.57	6.33	10.09	14.20
110	.457	.651	1.01	1.73	2.72	3.93	6.96	11.10	15.62
120	.498	.711	1.10	1.89	2.97	4.29	7.59	12.11	17.04
130	.540	.770	1.19	2.05	3.22	4.65	8.23	13.12	18.46
140	.581	.829	1.28	2.20	3.46	5.00	8.86	14.13	19.88
150	.623	.888	1.37	2.36	3.71	5.36	9.49	15.14	21.30
160	.664	.948	1.46	2.52	3.96	5.72	10.12	16.15	22.72
170	.706	1.01	1.55	2.68	4.21	6.07	10.76	17.15	24.14
180	.747	1.07	1.65	2.83	4.45	6.43	11.39	18.16	25.56
190	.789	1.13	1.74	2.99	4.70	6.79	12.02	19.17	26.98
200	.830	1.18	1.83	3.15	4.95	7.15	12.66	20.18	28.40
300	1.25	1.78	2.74	4.72	7.42	10.72	18.98	30.27	42.60
400	1.66	2.37	3.66	6.30	9.90	14.29	25.31	40.36	56.80
500	2.08	2.96	4.57	7.87	12.37	17.87	31.64	50.46	71.00
1,000	4.15	5.92	9.14	15.75	24.74	35.73	63.28	100.91	141.99
1,500	6.23	8.88	13.72	23.62	37.12	53.60	94.92	151.37	212.99
2,000	8.30	11.84	18.29	31.49	49.49	71.47	126.56	201.82	283.99
2,500	10.38	14.80	22.86	39.36	61.86	89.33	158.20	252.28	354.98
3,000	12.45	17.77	27.43	47.24	74.23	107.20	189.84	302.73	425.98
3,500	14.53	20.73	32.00	55.11	86.61	125.07	221.48	353.19	496.98
4,000	16.60	23.69	36.58	62.98	98.98	142.93	253.12	403.64	567.97
4,500	18.68	26.65	41.15	70.86	111.35	160.80	284.76	454.10	638.97
5,000	20.75	29.61	45.72	78.73	123.72	178.67	316.40	504.55	709.97
1 mile	22	31	48	83	131	189	334	533	750
2	44	63	97	166	261	377	668	1,066	1,500
3	66	94	145	249	392	566	1,002	1,598	2,249
4	88	125	193	333	523	755	1,336	2,131	2,999
5	110	156	241	416	653	943	1,671	2,664	3,749
10			483	831	1,307	1,887	3,341	5,328	7,497
15			724	1,247	1,960	2,830	5,012	7,992	11,246
20			966	1,663	2,613	3,773	6,682	10,656	14,995
25				2,078	3,266	4,717	8,353	13,320	18,743
30				2,494	3,920	5,660	10,024	15,984	22,492
35				2,910	4,573	6,604	11,694	18,648	26,240
40				3,326	5,226	7,547	13,365	21,312	29,989
45				3,741	5,879	8,490	15,035	23,976	33,738
50				4,157	6,533	9,434	16,706	26,640	37,486
55				4,573	7,186	10,377	18,377	29,304	41,235
60				4,988	7,839	11,320	20,047	31,968	44,984
65				5,404	8,492	12,264	21,718	34,632	48,732

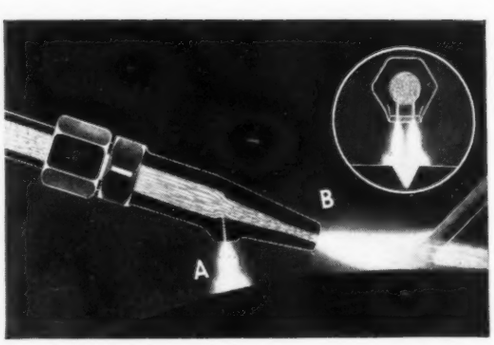
Pipe lines are dependable—
when Multi-Flame Lindewelded



All joints in this 20-inch pipe line are made permanently leakproof by Multi-Flame Lindewelding.

MULTI-Flame Lindewelding confers a new degree of dependability upon pipe-line construction. A properly made Lindeweld is consistently as strong as the pipe itself, even when the tensile strength of the pipe base material is as high as 110,000 pounds per square inch. At the same time, the weld remains tough, ductile and permanently leakproof throughout the life of the pipe.

The Linde organization can help you utilize the many benefits of Lindewelding on your future pipe-line projects. Ask your Linde representative for a copy of "Lindewelding Pipe Lines" or write the Linde office near you for full information. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.



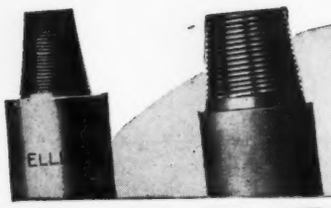
This schematic cross section shows the Multi-Flame Lindewelding Head in action. The small flames, A, preheat the pipe while the main flame, B, melts the welding rod and postheats the weld. In the circle is a cross-sectional view through the preheating flames, A.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

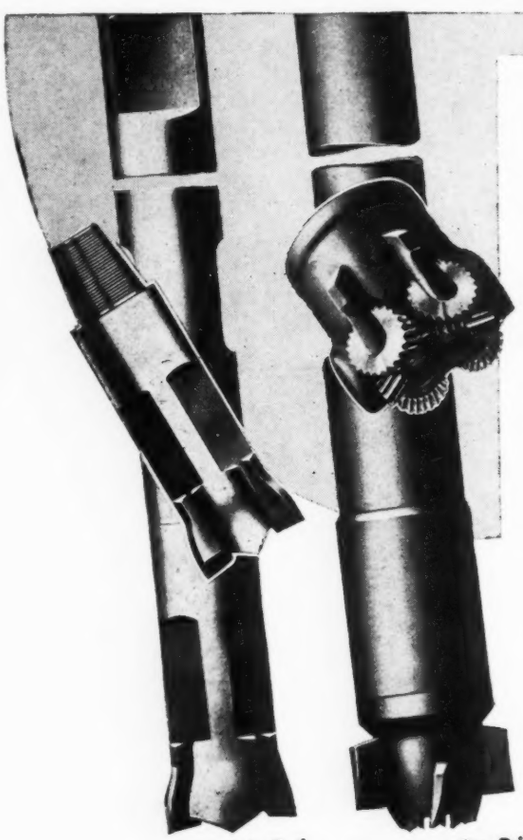
STORAGE CAPACITY OF GAS SANDS, THOUSAND CU. FT. PER ACRE FT.
(Temperature 60 deg. fahr.)

Bottom hole pressure, lb. per sq. in. gauge	Percent porosity								
	10	12	14	16	18	20	22	24	26
10	7.313	8.776	10.24	11.70	13.16	14.63	16.09	17.55	19.01
20	10.27	12.32	14.38	16.43	18.49	20.54	22.60	24.65	26.70
30	13.23	15.87	18.52	21.16	23.81	26.46	29.10	31.75	34.39
40	16.18	19.42	22.66	25.90	29.13	32.37	35.61	38.84	42.08
50	19.14	22.97	26.80	30.63	34.46	38.28	42.11	45.94	49.77
60	22.10	26.52	30.94	35.36	39.78	44.20	48.62	53.04	57.46
70	25.06	30.07	35.08	40.09	45.10	50.11	55.12	60.14	65.15
80	28.01	33.62	39.22	44.82	50.42	56.03	61.63	67.23	72.84
90	30.97	37.17	43.36	49.55	55.75	61.94	68.14	74.33	80.52
100	33.93	40.71	47.50	54.29	61.07	67.86	74.64	81.43	88.21
110	36.89	44.26	51.64	59.02	66.39	73.77	81.15	88.53	95.90
120	39.84	47.81	55.78	63.75	71.72	79.69	87.65	95.62	103.59
130	42.80	51.36	59.92	68.48	77.04	85.60	94.16	102.72	111.28
140	45.76	54.91	64.06	73.21	82.36	91.51	100.67	109.82	118.97
150	48.71	58.46	68.20	77.94	87.69	97.43	107.17	116.91	126.66
160	51.67	62.01	72.34	82.67	93.01	103.34	113.68	124.01	134.35
170	54.63	65.55	76.48	87.41	98.33	109.26	120.18	131.11	142.04
180	57.59	69.10	80.62	92.14	103.66	115.17	126.69	138.21	149.72
190	60.54	72.65	84.76	96.87	108.98	121.09	133.20	145.30	157.41
200	63.50	76.20	88.90	101.60	114.30	127.00	139.70	152.40	165.10
210	66.46	79.75	93.04	106.33	119.62	132.92	146.21	159.50	172.79
220	69.42	83.30	97.18	111.06	124.95	138.83	152.71	166.60	180.48
230	72.37	86.85	101.32	115.80	130.27	144.74	159.22	173.69	188.17
240	75.33	90.40	105.46	120.53	135.59	150.66	165.72	180.79	195.86
250	78.29	93.94	109.60	125.26	140.92	156.57	172.23	187.89	203.55
260	81.24	97.49	113.74	129.99	146.24	162.49	178.74	194.99	211.23
270	84.20	101.04	117.88	134.72	151.56	168.40	185.24	202.08	218.92
280	87.16	104.59	122.02	139.45	156.89	174.32	191.75	209.18	226.61
290	90.12	108.14	126.16	144.19	162.21	180.23	198.25	216.28	234.30
300	93.07	111.68	130.30	148.92	167.53	186.15	204.76	223.37	241.99
310	96.03	115.24	134.44	153.65	172.85	192.06	211.27	230.47	249.68
320	98.99	118.78	138.58	158.38	178.18	197.97	217.77	237.57	257.37
330	101.94	122.33	142.72	163.11	183.50	203.89	224.28	244.67	265.06
340	104.90	125.88	146.86	167.84	188.82	209.80	230.78	251.76	272.74
350	107.86	129.43	151.00	172.57	194.15	215.72	237.29	258.86	280.43
360	110.82	132.98	155.14	177.31	199.47	221.63	243.80	265.96	288.12
370	113.77	136.53	159.28	182.04	204.79	227.55	250.30	273.06	295.81
380	116.73	140.08	163.42	186.77	210.12	233.46	256.81	280.15	303.50
390	119.69	143.63	167.56	191.50	215.44	239.38	263.31	287.25	311.19
400	122.65	147.17	171.70	196.23	220.76	245.29	269.82	294.35	318.88
410	125.60	150.72	175.84	200.96	226.08	251.20	276.33	301.45	326.57
420	128.56	154.27	179.98	205.70	231.41	257.12	282.83	308.54	334.26
430	131.52	157.82	184.12	210.43	236.73	263.03	289.34	315.64	341.94
440	134.47	161.37	188.26	215.16	242.05	268.95	295.84	322.74	349.63
450	137.43	164.92	192.40	219.89	247.38	274.86	302.35	329.84	357.32
460	140.39	168.47	196.54	224.62	252.70	280.78	308.85	336.93	365.01
470	143.35	172.01	200.68	229.35	258.02	286.69	315.36	344.03	372.70
480	146.30	175.56	204.82	234.08	263.35	292.61	321.87	351.13	380.39
490	149.26	179.11	208.96	238.82	268.67	298.52	328.37	358.22	388.08
500	152.22	182.66	213.10	243.55	273.99	304.44	334.88	365.32	395.77
550	167.00	200.40	233.81	267.21	300.61	334.01	367.41	400.81	434.21
600	181.79	218.15	254.51	290.86	327.22	363.58	399.94	436.30	472.65
650	196.58	235.89	275.21	314.52	353.84	393.15	432.47	471.78	511.10
700	211.36	253.63	295.91	338.18	380.45	422.72	465.00	507.27	549.54
750	226.15	271.38	316.61	361.84	407.07	452.30	497.53	542.76	587.99
800	240.93	289.12	337.31	385.50	433.68	481.87	530.06	578.24	626.43
850	255.72	306.86	358.01	409.15	460.30	511.44	562.59	613.73	664.87
900	270.51	324.61	378.71	432.81	486.91	541.01	595.11	649.22	703.32
950	285.29	342.35	399.41	456.47	513.53	570.59	627.64	684.70	741.76
1000	300.08	360.09	420.11	480.13	540.14	600.16	660.17	720.19	780.21



USED *Exclusively*
FOR 15 YEARS IN

ELLIOTT'S CORING SERVICE TO OIL COMPANIES



Elliott Cable Tool Core Drill

Elliott Rotary Core Drill

ELLIOTT Coring Service to oil companies is well and favorably known. It has been in existence ever since Elliott cored the first oil well on a commercial basis fifteen years ago; and has been conducted on a strictly competitive price, performance and service basis. Low manufacturing, operating and maintenance costs; together with superior performance and recoveries always have been vitally essential to the continuation of this service.

Elliott Core Drills—designed, developed and manufactured by this company—have been used exclusively in Elliott Coring Service. The fact that they not only have enabled, but are largely responsible for, such consistent growth and leadership in this highly competitive field as Elliott has enjoyed, is convincing proof of their superiority in actual coring operations.

This in turn is a direct and logical result of Elliott's continued daily experience in coring practice. Elliott Core Drills are built by the men who use them—who know all the coring problems—and all the answers. They are the best, the most practical core drills these practical core drillers know how to build for their own use.

Your drilling crews also can use these successful coring tools, and be assured of satisfactory recoveries. They are BUILT FOR USE by Elliott field crews, as well as by drilling crews in all parts of the world. Write for descriptive catalog, stating whether rotary or cable tools are used.

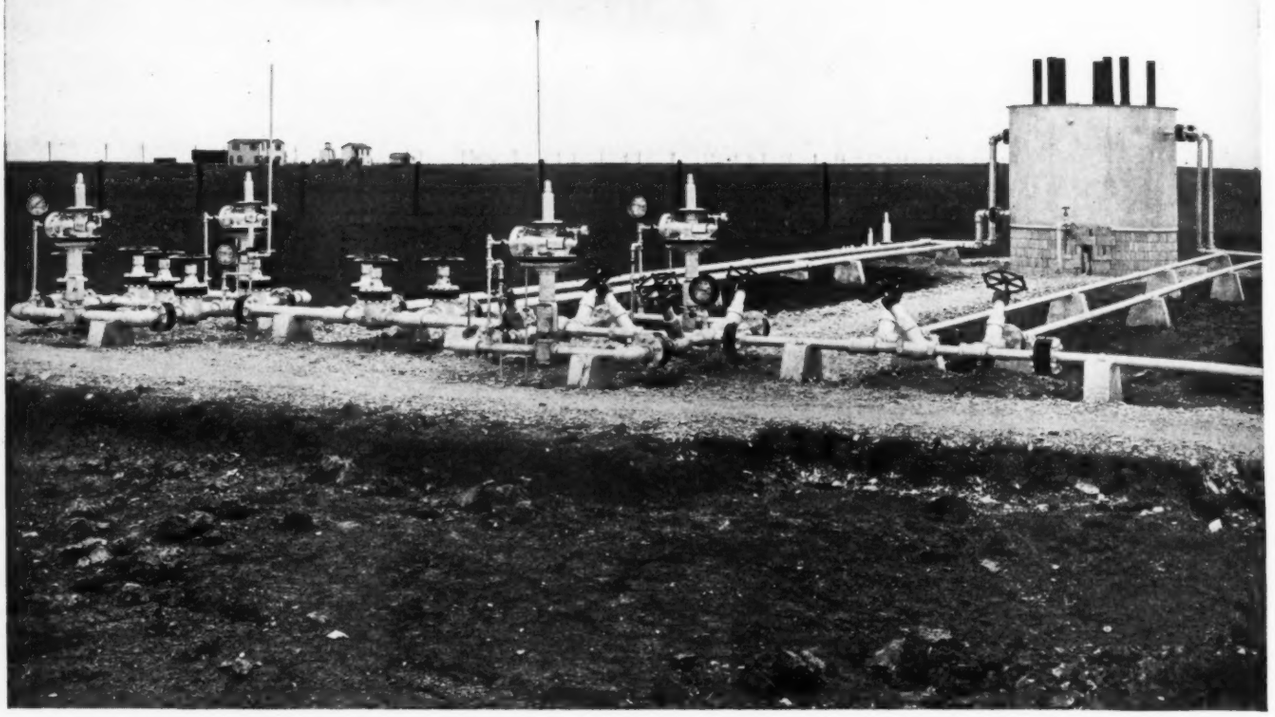
CORE DRILLS

ELLIOTT CORE DRILLING COMPANY
4731 East 52nd Drive, Los Angeles, California, U.S.A.
Export Office: 420 Lexington Avenue, New York City

PRESSURE CONVERSION TABLE

Water, in.	Mercury, in.	Mercury, in.	Lb. per sq. in.	Water, ft.	Lb. per sq. in.	Water, ft.	Lb. per sq. in.	Water, ft.
1.0	.074	.2	.098	.23	20	46.2	335	773.5
1.5	.111	.4	.196	.45	25	57.7	340	785.0
2.0	.148	.6	.294	.68	30	69.3	345	796.6
2.5	.184	.8	.391	.90	35	80.8	350	808.1
3.0	.221	1.0	.489	1.13	40	92.4	355	819.7
3.5	.258	1.5	.734	1.69	45	103.9	360	831.2
4.0	.295	2.0	.979	2.26	50	115.4	365	842.8
4.5	.332	2.5	1.223	2.82	55	127.0	370	854.3
5.0	.369	3.0	1.468	3.39	60	138.5	375	865.8
5.5	.406	3.5	1.713	3.95	65	150.1	380	877.4
6.0	.443	4.0	1.957	4.52	70	161.6	385	888.9
6.5	.479	4.5	2.202	5.08	75	173.2	390	900.5
7.0	.516	5.0	2.447	5.65	80	184.7	395	912.0
7.5	.553	5.5	2.692	6.21	85	196.3	400	923.6
8.0	.590	6.0	2.936	6.78	90	207.8	405	935.1
8.5	.627	6.5	3.181	7.34	95	219.3	410	946.7
9.0	.664	7.0	3.426	7.91	100	230.9	415	958.2
9.5	.701	7.5	3.670	8.47	105	242.4	420	969.7
10.0	.738	8.0	3.915	9.04	110	254.0	425	981.3
10.5	.774	8.5	4.160	9.60	115	265.5	430	992.8
11.0	.811	9.0	4.404	10.17	120	277.1	435	1004.4
11.5	.848	9.5	4.649	10.73	125	288.6	440	1015.9
12.0	.885	10.0	4.894	11.30	130	300.2	445	1027.5
12.5	.922	10.5	5.138	11.86	135	311.7	450	1039.0
13.0	.959	11.0	5.383	12.43	140	323.2	455	1050.6
13.5	.996	11.5	5.628	12.99	145	334.8	460	1062.1
14.0	1.033	12.0	5.872	13.56	150	346.3	465	1073.6
14.5	1.069	12.5	6.117	14.12	155	357.9	470	1085.2
15.0	1.106	13.0	6.362	14.69	160	369.4	475	1096.7
15.5	1.143	13.5	6.606	15.25	165	381.0	480	1108.3
16.0	1.180	14.0	6.851	15.82	170	392.5	485	1119.8
16.5	1.217	14.5	7.096	16.38	175	404.1	490	1131.4
17.0	1.254	15.0	7.341	16.95	180	415.6	495	1142.9
17.5	1.291	15.5	7.585	17.51	185	427.2	500	1154.5
18.0	1.328	16.0	7.830	18.08	190	438.7	510	1177.5
18.5	1.364	16.5	8.075	18.64	195	450.2	520	1200.6
19.0	1.401	17.0	8.319	19.21	200	461.8	530	1223.7
19.5	1.438	17.5	8.564	19.77	205	473.3	540	1246.8
20.0	1.475	18.0	8.809	20.34	210	484.9	550	1269.9
20.5	1.512	18.5	9.053	20.90	215	496.4	560	1293.0
21.0	1.549	19.0	9.298	21.47	220	508.0	570	1316.1
21.5	1.586	19.5	9.543	22.03	225	519.5	580	1339.2
22.0	1.623	20.0	9.787	22.60	230	531.1	590	1362.3
22.5	1.659	20.5	10.032	23.16	235	542.6	600	1385.4
23.0	1.696	21.0	10.277	23.73	240	554.1	610	1408.4
23.5	1.733	21.5	10.521	24.29	245	565.7	620	1431.5
24.0	1.770	22.0	10.766	24.86	250	577.2	630	1454.6
24.5	1.807	22.5	11.011	25.42	255	588.8	640	1477.7
25.0	1.844	23.0	11.255	25.99	260	600.3	650	1500.8
25.5	1.881	23.5	11.500	26.55	265	611.9	660	1523.9
26.0	1.918	24.0	11.745	27.12	270	623.4	670	1547.0
26.5	1.954	24.5	11.989	27.68	275	635.0	680	1570.1
27.0	1.991	25.0	12.234	28.25	280	646.5	690	1593.2
27.5	2.028	25.5	12.479	28.81	285	658.0	700	1616.2
28.0	2.065	26.0	12.724	29.38	290	669.6	710	1639.3
28.5	2.102	26.5	12.968	29.94	295	681.1	720	1662.4
29.0	2.139	27.0	13.213	30.51	300	692.7	730	1685.5
29.5	2.176	27.5	13.458	31.07	305	704.2	740	1708.6
30.0	2.213	28.0	13.702	31.64	310	715.8	750	1731.7
30.5	2.249	28.5	13.947	32.20	315	727.3	760	1754.8
31.0	2.286	29.0	14.192	32.77	320	738.9	770	1777.9
31.5	2.323	29.5	14.436	33.33	325	750.4	780	1801.0
32.0	2.360	30.0	14.681	33.90	330	761.9	790	1824.0

"Reliable" Is the Word



FOR MASONEILAN REGULATORS

All over the world the Masoneilan trademark on pressure and vacuum regulators is the accepted symbol of dependable service —an assurance of years in the line and a minimum of hours in the repair shop.

And this is no accident. Over half a century of practical experience goes into their design; only the best of materials go into their construction; painstaking care and precision standards guide their manufacture and assembly; actual operating conditions are duplicated in their thorough testing.

Specify Masoneilan Regulators for gas, oil, water, air and steam service under all conditions. Write our office nearest you for complete information.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY, 1193 ADAMS STREET, BOSTON, MASS., U. S. A.

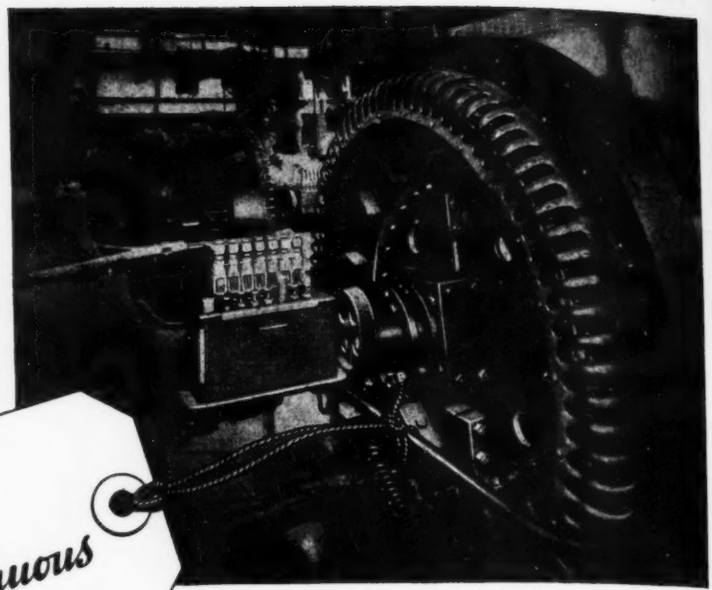
New York Philadelphia Pittsburgh Chicago Tulsa St. Louis Houston Los Angeles

VISCOSITY CONVERSION FACTORS

Saybolt universal seconds	Engler degrees	Absolute viscosity, centipoises,[1] also relative viscosity	Kinematic viscosity, poises per g. per cc, n/d	Redwood No. 1 seconds	Saybolt Furol seconds	Redwood admiralty seconds
32	1.08	1.41	0.0141			30
34	1.14	2.19	.0219			31
36	1.19	2.92	.0292			33
38	1.25	3.63	.0363			34
40	1.31	4.30	.0430			36
42	1.37	4.95	.0495			38
44	1.43	5.59	.0559			39
46	1.48	6.21	.0621			41
48	1.53	6.81	.0681			43
50	1.58	7.40	.0740			44
55	1.73	8.83	.0883			48
60	1.88	10.20	.1020			53
65	2.03	11.53	.1153			57
70	2.17	12.83	.1283			61
75	2.31	14.10	.1410			65
80	2.46	15.35	.1535			69
85	2.59	16.58	.1658			73
90	2.74	17.80	.1780			77
95	2.88	19.00	.1900			81
100	3.02	20.20	.2020	10	15	86
110	3.31	22.56	.2256	11	16	94
120	3.60	24.90	.2490	12	17	102
130	3.69	27.21	.2721	13	18	111
140	4.19	29.51	.2951	13	18	119
160	4.77	34.07	.3407	15	20	136
180	5.35	38.60	.3860	17	22	153
200	5.92	43.10	.4310	19	23	170
225	6.64	48.70	.4870	21	26	191
250	7.35	54.28	.5428	23	28	212
300	8.79	65.40	.6540	28	32	254
350	10.25	76.49	.7649	32	37	296
400	11.68	87.55	.8755	37	42	338
450	13.00	98.60	.9860	42	47	380
500	14.00	109.6	1.096	46	52	422
550	16.00	120.7	1.207	50	56	465
600	17.00	131.7	1.317	55	61	507
650	19.00	142.7	1.427	60	66	549
700	20.00	153.7	1.537	64	71	591
800	23.00	175.8	1.758	74	81	676
900	26.00	197.8	1.978	83	91	760
1000	29.00	219.8	2.198	92	101	845
1500	43.00	329.9	3.299	138	150	1267
2000	58.00	439.9	4.399	184	200	1690
2500	72.00	549.9	5.499	230	250	2112
3000	87.00	659.9	6.599	276	300	2535
3500	101.00	769.9	7.699	322	350	2957

[1]Values in this column must be multiplied by the specific gravity of the fluid at the temperature of the measurement to complete the conversion.

Boost refinery efficiency with G-E synchronous Motors



Ok for continuous service

G-E synchronous motors, each direct connected to reciprocating compressor for refrigeration service. In cracking plant of large California oil refinery

A COMPLETE LINE OF ELECTRIC EQUIPMENT FOR REFINERIES INCLUDES:

GIVE the efficiency of your refinery a boost by using G-E synchronous motors to drive the pumps, blowers, and compressors in your plant that operate at low or moderate speeds.

The design of these motors makes them highly efficient drives for such applications; in addition, they can cut power bills considerably by their power-factor-improvement characteristic.

Built for Long-time Service

Long-time operation at low maintenance is assured by the welded-steel-plate construction of the frame, the sturdy rotor, and the unusually protective insulation on the windings. These and other features developed by G-E engineers through years of experience in synchronous-motor design make these motors outstandingly dependable and efficient.

Adaptable for Oil-refinery Requirements

They can be furnished with a wide variety of electrical and mechanical modifications and with control to match, to meet special conditions of voltage and power-factor; for use in moisture-laden or explosive-gas atmospheres; and for use in places where they may be exposed to splashing or dripping liquids. Call the nearest G-E representative for further information. General Electric Company, Schenectady, N. Y.

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